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A

HISTORY OF THE EARTH,

AND

ANIMATED NATURE.

Illustrated with Engravings,

And a Portrait of the Author.

A NEW EDITION, WITH CORRECTIONS AND ADDITIONS.

IN THREE VOLUMES.

BY OLIVER GOLDSMITH, M. B.

VOLUME THE THIRD.

LONDON:

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A

HISTORY

OF

FISHES.

PART I.

OF FISHES IN GENERAL.

CHAPTER I.

INTRODUCTION.

The ocean is the great receptacle of fishes. It has been thought, by some, that all fish are naturally of that salt element, and that they have mounted up into fresh water by some accidental migration. A few still swim up rivers to deposit their spawn; but of the great body of fishes, of which the size is enormous and the shoals are endless, those all keep to the sea, and would quickly expire in fresh water. In that extensive and undiscovered abode, millions reside, whose manners are a secret to us, and whose very form is unknown. The curiosity of mankind, indeed, has drawn some from their depths, and his wants many more: with the figure of these at least he is acquainted; but for their pursuits, migrations, societies, antipathies, pleasures, times of gestation, and manner of bringing forth, all these are hidden in the turbulent element that protects them.

The number of fish to which we have given names, and of the figure, at least, of which we know something, according to Linnæus, are above four hundred. Thus to appearance, indeed, the history of fish is tolerably copious; but when we come to examine, it will be found, that of the greatest part of these we know very little. Those qualities, singularities, or advantages, that render animals worth naming, still remain to be discovered. The history of fishes, therefore, has little in it entertaining: for our philosophers hitherto, instead of studying their nature, have been employed in increasing their catalogues; and the reader, instead of observations of facts, is presented with a long list of names, that disgust him with their barren superfluity. It must displease him to see the language of a science increasing, while the science itself has nothing to repay the increasing tax laid upon his memory.

Most fish offer us the same external form; sharp at either end, and swelling in the middle, by which they are enabled to traverse the fluid which they inhabit with greater celerity and ease. The

peculiar shape which nature has granted to most fishes, we endeavour to imitate in such vessels as are designed to sail with the greatest swiftness: however, the progress of a machine moved forward in the water by human contrivance, is nothing to the rapidity of an animal destined by nature to reside there. Any of the large fish overtake a ship in full sail with great ease, play round it without effort, and outstrip it at pleasure. Every part of the body seems exerted in this dispatch; the fins, the tail, and the motion of the whole back bone, assist progression, and it is to that flexibility of body, at which art cannot arrive, that fishes owe their great velocity.

The chief instruments in a fish's motion are the fins, which in some fish are much more numerous than in others. A fish completely fitted for sailing, is furnished with not less than two pair; also three single fins, two above and one below. Thus equipped, it migrates with the utmost rapidity, and takes voyages of a thousand leagues in a season. But it does not always happen that such fish as have the greatest number of fins have the swiftest motion: the shark is thought to be one of the swiftest swimmers, yet it wants the ventral or belly fins; the haddock does not move so swift, yet it is completely fitted for motion.

But the fins serve not only to assist the animal in progression, but in rising or sinking, in turning, or even leaping out of the water. To answer these purposes, the pectoral fins serve, like oars, to push the animal forward; they are placed at some little distance behind the opening of the gills; they are generally large and strong, and answer the same purposes to the fish in the water, as wings do to a bird in the air. With the help of these, and by their continued motion, the flying fish is sometimes seen to rise out of the water, and to fly above a hundred yards, till, fatigued with its exertions, it is obliged to sink down again. These also serve to balance the fish's head when it is too large for the body, and keep it from tumbling prone to the bottom, as is seen in large headed fishes, when the pectoral fins are cut off. Next these are seen the ventral fins, placed toward the lower part of the body, under the belly: these are always seen to lie flat on the water, in whatever situation the fish may be, and they serve rather to depress the fish in its element, than to assist progressive motion. The dorsal fin is situated along the ridge of the back, and serves to keep it *in equilibrio*, as also to assist its progressive motion. In many fishes this is wanting; but in all flat fishes it is very large, as the pectoral fins are proportionably small. The anal fin occupies that part of the fish which lies between the anus and the tail; and this serves to keep the fish in its upright or vertical situation. Lastly, the tail, which in some fishes is flat, and upright in others, seems the grand instrument of motion: the fins are all but subservient to it, and give direction to its great impetus, by which the fish seems to dart forward with so much velocity. To explain all this by experiment, a carp is taken, and put into a large vessel

The fish, in a state of repose, spreads all its fins, and seems to rest upon its pectoral and ventral fins near the bottom: if the fish folds up (for it has the power of folding) either of its pectoral fins, it inclines to the same side; folding the right pectoral fin, the fish inclines to the right side; folding the left fin, it inclines to that side in turn. When the fish desires to have a retrograde motion, striking with the pectoral fins in a contrary direction effectually produces it. If the fish desires to turn, a blow from the tail sends it about; but if the tail strikes both ways, then the motion is progressive. In pursuance of these observations, if the dorsal and ventral fins be cut off, the fish reels to the right and left, and endeavours to supply its loss by keeping the rest of its fins in constant employment. If the right pectoral fin be cut off, the fish leans to that side; if the ventral fin on the same side be cut away, then it loses its equilibrium entirely. When the tail is cut off, the fish loses all motion, and gives itself up to where the water impels it.

From hence it appears, that each of these instruments has a peculiar use assigned it, but, at the same time, that they all conspire to assist each other's motions. Some fish are possessed of all, whose motions are yet not the swiftest; others have but a part, and yet dart in the water with great rapidity. The number, the size, and the situation of the fins, therefore, seem rather calculated to correspond with the animal's figure, than solely to answer the purposes of promoting its speed. Where the head is large and heavy, there the pectoral fins are large, and placed forward, to keep it from oversetting. Where the head is small, or produced out into a small beak, and therefore not too heavy for the tail, the pectoral fins are small, and the ventral fins totally wanting.

As most animals that live upon land are furnished with a covering to keep off the injuries of the weather, so all that live in the water are covered with a slimy glutinous matter, that, like a sheath, defends their bodies from the immediate contact of the surrounding fluid. This substance may be considered as a secretion from the pores of the animal's body, and serving, not only to defend, but to assist the fish's easy progress through the water. Beneath this, in many kinds, is found a strong covering of scales, that, like a coat of mail, defends it still more powerfully; and under that, before we come to the muscular parts of the body, an oily substance, which supplies the requisite warmth and vigour.

The fish, thus protected and fitted for motion in its natural element, seems as well furnished with the means of happiness as quadrupeds or birds; but if we come to examine its faculties more nearly, we shall find it very much their inferior. The sense of touching, which beasts and birds have in a small degree, the fish, covered up in his own coat of mail, can have but little acquaintance with.

The sense of smelling, which in beasts is so exquisite, and among birds is not wholly unknown, seems given to fishes in a

very moderate proportion. It is true that all fishes have one or more nostrils; and even those that have not the holes perceptible without, yet have the proper formation of the bones for smelling within. But as air is the only medium we know for the distribution of odours, it cannot be supposed that these animals, residing in water, can be possessed of any power of being affected by them. If they have any perception of smells, it must be in the same manner as we distinguish by our taste; and it is probable the olfactory membrane in fish serves them instead of a distinguishing palate: by this they judge of substances, that, from tincturing the water with their vapours, are thus sent to the nostrils of the fish, and no doubt produce some kind of sensation. This most probably must be the use of that organ in those animals; as otherwise there would be the instruments of a sense provided for them, without any power in them of enjoyment.

As to tasting, they seem to make very little distinction; the palate of most fish is hard and bony, and consequently incapable of the powers of relinquishing different substances. This sense among quadrupeds, who possess it in some degree, arises from the soft pliancy of the organ, and the delicacy of the skin which covers the instruments of tasting; it may be considered in them as a more perfect and delicate kind of feeling: in the bony palate of fish, therefore, all powers of distinguishing are utterly taken away; and we have accordingly often seen these voracious animals swallow the fisherman's plummet instead of the bait.

Hearing in fishes is found still more imperfect, if it be found at all. Certain it is, that anatomists have not been able to discover, except in the whale kind, the smallest traces of an organ, either within or without the head of fishes. It is true that in the centre of the brain of some fishes are found now and then some little bones, the number and situation of which are entirely accidental. These bones M. Klein has supposed to constitute the organ of hearing; but if we consider their entire dissimilitude to the bones that serve for hearing in other animals, we shall be of another opinion. The greatest number of fishes are deprived of these bones entirely; some fish have them in small numbers, and others in abundance, yet neither testify any excellence or defect in hearing. Indeed, of what advantage would this sense be to animals that are incapable of making themselves heard? They have no voice to communicate with each other, and consequently have no need of an organ for hearing. Mr. Gouan, who kept some gold fishes in a vase, informs us, that whatever noise he made he could neither disturb nor terrify them: he hallooed as loud as he could, putting a piece of paper between his mouth and the water to prevent the vibrations from affecting the surface, and the fishes still seemed insensible; but when the paper was removed, and the sound had its full play upon the water, the fishes seemed instantly to feel the change, and shrunk to the bottom. From this we may learn, that fishes are as deaf as they are mute; and that when they

seem to hear the call of a whistle or a bell at the edge of a pond, it is rather the vibrations of the sound that affect the water by which they are excited, than any sounds that they hear.

Seeing seems to be the sense fishes are possessed of in the greatest degree; and yet even this seems obscure, if we compare it to that of other animals. The eye in almost all fish is covered with the same transparent skin that covers the rest of the head, and which probably serves to defend it in the water, as they are without eye-lids. The globe is more depressed anteriorly, and is furnished behind with a muscle, which serves to lengthen or flatten it, according to the necessities of the animal. The crystalline humour, which in quadrupeds is flat and of the shape of a button mould, in fishes is as round as a pea, or sometimes oblong, like an egg. From all this it appears that fish are extremely near-sighted, and that even in the water they can see objects at a very small distance. This distance might very easily be ascertained, by comparing the refraction of bodies in the water with that formed by a lens that is spherical. Those unskilled in mathematical calculations will have a general idea of this from the glasses used by near-sighted people. Those whose crystalline humour is too convex, or, in other words, too round, are always very near-sighted, and obliged to use concave glasses to correct the imperfections of nature. The crystalline humour of fish is so round that it is not in the power of any glasses, much less of water, to correct their vision. This crystalline humour in fishes all must have seen, being that little hard pea-like substance which is found in their eyes after boiling. In the natural state it is transparent, and not much harder than a jelly.

From all this it appears, how far fish fall behind terrestrial animals in their sensations, and consequently in their enjoyments. Even their brain, which is by some supposed to be of a size with every animal's understanding, shows that fish are inferior even to birds in this particular. It is divided into three parts, surrounded with a whitish froth, and gives off nerves as well to the sense of sight as of smelling. In some fish it is grey, in others white; in some it is flatted, in others round; but in all extremely small, compared to the bulk of the animal.

Thus nature seems to have fitted these animals with appetites and powers of an inferior kind, and formed them for a sort of passive existence in the obscure and heavy element to which they are consigned. To preserve their own existence, and to continue it to their posterity, fill up the whole circle of their pursuits and enjoyments: to these they are impelled rather by necessity than choice, and seem mechanically excited to every fruition. Their senses are incapable of making any distinctions, but they drive forward in pursuit of whatever they can swallow, conquer, or enjoy.

A ceaseless desire of food seems to give the ruling impulse to all their motions. This appetite impels them to encounter every danger, and indeed their rapacity seems insatiable. Even when

taken out of the water, and almost expiring, they greedily swallow the very bait by which they were allured to destruction.

The maw is in general placed next the mouth, and though possessed of no sensible heat, is, however, endued with a surprising faculty of digestion. Its digestive power seems in some measure to increase with the quantity of food it is supplied with, a single pike having been known to devour a hundred roaches in three days. Its faculties also are as extraordinary; for it digests not only fish, but much harder substances, prawns, crabs, and lobsters, shells and all. These the cod or the sturgeon will not only devour, but dissolve down, though their shells are so much harder than the sides of the stomach which contains them. This amazing faculty in the cold maw of fishes has justly excited the curiosity of philosophers, and has effectually overturned the system of those who supposed that the heat of the stomach was alone a sufficient instrument for digestion. The truth seems to be, and some experiments of the skilful Dr. Hunter seem to evince, that there is a power of animal assimilation lodged in the stomach of all creatures, which we can neither describe nor define, converting the substances they swallow into a fluid fitted for their own peculiar support. This is done neither by trituration, nor by warmth, nor by motion, nor by a dissolving fluid, nor by their united efforts; but by some principle in the stomach yet unknown, which acts in a different manner from all kinds of artificial maceration. The meat taken into the stomach or maw is often seen, though very near being digested, still to retain its original form, and ready for a total dissolution, while it appears to the eye as yet untouched by the force of the stomach. This animal power is lodged in the maw of fishes in a greater degree that in any other creatures; their digestive powers are quick, and their appetites ever are craving.

Yet though fish are thus hungry, and for ever prowling, no animals can suffer the want of food for so long a time. The gold and silver fish we keep in vases seem never to want any nourishment at all: whether it be that they feed on the water insects, too minute for our observation, or that water alone is a sufficient supply, is not evident; but they are often seen for months without apparent sustenance. Even the pike, the most voracious of fishes, will live in a pond where there is none but himself, and what is more extraordinary, will be often found to thrive there.

Still, however, fish are, of all other animals, the most voracious and insatiable. Whatever any of them is able to swallow possessed of life, seems to be considered as the most desirable food. Some that have very small mouths feed upon worms and the spawn of other fish; others, whose mouths are larger, seek larger prey, it matters not of what kind, whether of another or their own. Those with the largest mouths pursue almost every thing that has life, and often meet each other in fierce opposition, when the fish with the largest swallow comes off with the victory, and devours its antagonist.

Thus are they irritated by the continual desire of satisfying their hunger; and the life of a fish, from the smallest to the greatest, is but one scene of hostility, violence, and evasion. But the smaller fry stand no chance in the unequal combat; and their usual way of escaping, is by swimming into those shallows where the greater are unable or too heavy to pursue. There they become invaders in turn, and live upon the spawn of larger fish, which they find floating upon the surface of the water. Yet there are dangers attending them in every place. Even in the shallows, the muscle, the oyster, and the scallop, lie in ambush at the bottom with their shells open, and whatever little fish inadvertently approaches into contact, they at once close their shells upon him, and devour the imprisoned prey at their leisure.

Nor is the pursuit of fishes, like that of terrestrial animals, confined to a single region, or to one effort: shoals of one species follow those of another through vast tracts of ocean, from the vicinity of the pole even down to the equator. Thus the cod, from the banks of Newfoundland, pursues the whiting, which flies before it even to the southern shores of Spain. The cachalot is said, in the same manner, to pursue a shoal of herrings, and to swallow thousands at a gulp.

This may be one cause of the annual migration of fishes from one part of the ocean to the other; but there are other motives, which come in aid of this also. Fishes may be induced to change the place of their residence, for one more suited to their constitutions, or more adapted to depositing their spawn. It is remarkable that no fish are fond of very cold waters, and generally frequent those places where it is warmest. Thus, in summer, they are seen in greatest numbers in the shallows near the shore, where the sun has power to warm the water to the bottom; on the contrary, in winter, they are found towards the bottom in the deep sea, for the cold of the atmosphere is not sufficiently penetrating to reach them at those great depths. Cold produces the same effect upon fresh water fishes; and when they are often seen dead after severe frosts, it is most probable that they have been killed by the severity of the cold, as well as by their being excluded by the ice from the air.

All fish live in the water, yet they all stand in need of air for their support. Those of the whale kind, indeed, breathe air in the same manner as we do, and come to the surface every two or three minutes to take a fresh inspiration; but those which continue entirely under water are yet under a necessity of being supplied with air, or they will expire in a very few minutes. We sometimes see all the fish of a pond killed, when the ice every where covers the surface of the water, and thus keeps off the air from the subjacent fluid. If a hole be made in the ice, the fish will be seen to come all to that part in order to take the benefit of a fresh supply. Should a carp in a large vase of water be placed under an air-pump, and then be deprived of its air, during the operation a

number of bubbles will be seen standing on the surface of the fish's body; soon after, the animal will appear to breathe swifter and with greater difficulty; it will be seen to rise towards the surface to get more air; the bubbles on its surface begin to disappear; the belly, that was before swoln, will then fall of a sudden, and the animal sinks expiring and convulsed at the bottom.

So very necessary is air to all animals, but particularly to fish, that, as was said, they can live but a few minutes without it: yet nothing is more difficult to be accounted for than the manner in which they obtain this necessary supply. Those who have seen a fish in the water, must remember the motion of its lips and its gills, or at least of the bones on each side that cover them. This motion in the animal is, without doubt, analogous to our breathing; but it is not air, but water, that the fish actually sucks in and spouts out through the gills at every motion. The manner of its breathing is this: the fish first takes in a quantity of water by the mouth, which is driven to the gills; these close and keep the water so swallowed from returning by the mouth, while the bony covering of the gills prevents it from going through them, until the animal has drawn the proper quantity of air from the body of water thus imprisoned; then the bony covers open and give it a free passage, by which means also the gills again are opened, and admit a fresh quantity of water. Should the fish be prevented from the free play of its gills, or should the bony covers be kept from moving, by a string tied round them, the animal would soon fall into convulsions, and die in a few minutes.

But though this be the general method of explaining respiration in fishes, the difficulty remains to know what is done with this air, which the fish in this manner separates from the water. There seems no receptacle for containing it; the stomach being the chief cavity within the body, is too much filled with aliment for that purpose. There is indeed a cavity, and that a pretty large one, I mean the air-bladder, or swim, which may serve to contain it for vital purposes; but that our philosophers have long destined to a very different use. The use universally assigned to the air-bladder is the enabling the fish to rise or sink in the water at pleasure, as that is dilated or compressed. The use assigned by the ancients for it, was to come in aid of the lungs, and to remain as a kind of store-house of air to supply the animal in its necessities. I own my attachment to this last opinion; but let us exhibit both with their proper share of evidence, and the reader must be left to determine.

The air-bladder is described as a bag filled with air, sometimes composed of one, sometimes of two, and sometimes of three divisions, situated towards the back of the fish, and opening into the maw or gullet. Those who contend that this bag is designed for raising or depressing the fish in the water, build upon the following experiment. A carp being put into the air-pump, and the air exhausted, the bladder is said to expand itself to such a degree,

that the fish swells in an extraordinary manner till the bladder bursts, and then the fish sinks and ever after continues to crawl at the bottom. On another occasion, the air-bladder was pricked and wounded, which let out its air; upon which the fish sunk to the bottom, and was not seen to rise after. From thence it is inferred, that the use of the air-bladder must be by swelling, at the will of the animal, thus to increase the surface of the fish's body, and thence diminishing its specific gravity, to enable it to rise to the top of the water, and keep there at pleasure. On the contrary, when the fish wants to descend, it is, say they, but to exhaust this bladder of its air; and the fish being thus rendered slimmer and heavier, consequently sinks to the bottom.

Such is the account given of the use of the air-bladder, no part of which seems to me well supported. In the first place, though nothing is more certain than that a carp put into the air-pump will swell, yet so will a mouse or a frog, and these we know to have no air-bladders. A carp will rise to the surface; but so will all fish that want air, whether they have an air-bladder or not. The air-bladder is said to burst in the experiment, but that I deny. The air-bladder is indeed found empty, but it has suffered no laceration, and may be distended by being blown into, like any other bladder that is sound. The fish, after the experiment, I grant, continues to creep at the bottom; and so will all fish that are sick and wounded, which must be the case with this after such an operation. Thus these facts prove nothing, but that, when the fish is killed in an air-pump, the air-bladder is found exhausted; and that it will naturally and necessarily be; for the drain of air by which the fish is supplied in the natural way, will necessarily oblige it to make use of all its hidden stores; and as there is a communication between the gullet and the air-bladder, the air which the latter contains will thus be obviously drawn away. But still farther, how comes the air-bladder, according to their hypothesis, to swell under the experiment of the air-pump? What is it that closes the aperture of that organ in such a manner as at last to burst it; or what necessity has the fish for dilating it to that violent degree? At most, it only wants to rise to the surface; and that the fish can easily do without so great a distension of the air-bladder. Indeed it should rather seem, that the more the air was wanted without, the less necessity there was for its being uselessly accumulated within; and to make the modern system consistent, the fish under the air pump, instead of permitting its bladder to be burst, would readily give up its contents, which, upon their supposition, all can do at pleasure.

But the truth is, the fish can neither increase nor diminish the quantity of air in its air-bladder at will, no more than we can that which is contained in our stomachs. The animal has no one muscle, much less a pair of muscles, for contracting or dilating this organ; its aperture is from the gullet, and what air is put into it must remain there, till the necessities, and not the will, of the animal call it forth as a supply.

But to put the matter past a doubt, many fish are furnished with an air-bladder that continually crawl at the bottom, such as the eel and the flounder; and many more are entirely without any bladder, that swim at ease in every depth, such as the anchovy and fresh-water gudgeon *. Indeed, the number of fish that want this organ is alone sufficient proof that it is not so necessary for the purposes of swimming; and as the ventral fins, which in all fish lie flat upon the water, seem fully sufficient to keep them at all depths, I see no great occasion for this internal philosophical apparatus for raising and depressing them. Upon the whole, the air-bladder seems adapted for different purposes than that of keeping the fish at different depths in the water; but whether it be to supply them with air when it is wanted from without, or for what other purpose, I will not take upon me to determine.

Hitherto we have seen fish in every respect inferior to land animals; in the simplicity of their conformation, in their senses, and their enjoyments; but of that humble existence which they have been granted by nature, they have a longer term than any other class of animated nature. "Most of the disorders incident to mankind," says Bacon, "arise from the changes and alterations of the atmosphere; but fishes reside in an element little subject to change; theirs is an uniform existence; their movements are without effort, and their life without labour. Their bones also, which are united by cartilages, admit of indefinite extension; and the different sizes of animals of the same kind among fishes are very various. They still keep growing; their bodies, instead of suffering the rigidity of age, which is the cause of natural decay in land animals, still continue increasing with fresh supplies; and as the body grows, the conduits of life furnish their stores in greater abundance. How long a fish, that seems to have scarce any bounds put to its growth, continues to live, is not ascertained; perhaps the life of a man would not be long enough to measure that of the smallest."

There have been two methods devised for determining the age of fishes, which are more ingenious than certain; the one is by the circles of the scales, the other by the transverse section of the back bone. The first method is this: When a fish's scale is examined through a microscope, it will be found to consist of a number of circles, one circle within another, in some measure resembling those which appear upon the transverse section of a tree, and supposed to offer the same information. For as in trees we can tell their age by the number of their circles, so in fishes we can tell theirs by the number of their circles in every scale, reckoning one ring for every year of the animal's existence. By this method, M. Buffon found a carp, whose scales he examined, to be not less than a hundred years old; a thing almost incredible, had we not several accounts in other authors which tend to confirm

* Redi.

the discovery. Gesner brings us an instance of one of the same age, and Albertus of one more than double that period.

The age of the skate and the ray, that want scales, may be known by the other method; which is, by separating the joints of the back-bone, and then minutely observing the number of rings which the surface where it was joined exhibits. By this the fish's age is said to be known, and perhaps with as much certainty as in the former instance.

But how unsatisfactory soever these marks may be, we have no reason to doubt the great age of some fishes. Those that have ponds, often know the oldest by their superior size. But the longevity of these animals is nothing when compared to their fecundity. All sorts, a few of the larger ones excepted, multiply their kind, some by hundreds, and some by millions. There are some that bring forth their young alive, and some that only produce eggs; the former are rather the least fruitful, yet even these are seen to produce in great abundance. The viviparous blenny, for instance, brings forth two or three hundred at a time, all alive, and playing round the parent together. Those who exclude their progeny in a more imperfect state, and produce eggs which they are obliged to leave to chance, either on the bottom at the edge of the water, or floating on the surface where it is deeper, are all much more prolific, and seem to proportion their stock to the danger there is of its consumption. Of these eggs thus deposited, scarce one in a hundred brings forth an animal; they are devoured by all the lesser fry that frequent the shores, by aquatic birds near the margin, and the larger fish in deep water. Still, however, there are enough for supplying the deep with inhabitants; and, notwithstanding their own rapacity, and that of fowls of various tribes, the numbers that escape are sufficient to relieve the wants of a very considerable part of mankind. Indeed, when we consider the numbers that a single fish is capable of producing, the amount will seem astonishing. If, for instance, we should be told of a being so very prolific, that in a single season it could bring forth as many of its kind as there are inhabitants in England, it would strike us with surprise; yet a single cod produces full that number. The cod spawns in one season, as Lewenhoeck assures us, above nine million of eggs or peas contained in one single roe. The flounder is commonly known to produce above one million; and the mackerel above five hundred thousand. Such an amazing increase, if permitted to come to maturity, would overstock nature, and even the ocean itself would not be able to contain, much less to provide for, the half of its inhabitants. But two wise purposes are answered by this amazing increase; it preserves the species in the midst of numberless enemies, and serves to furnish the rest with a sustenance adapted to their nature.

Fishes seem, all except the whale kind, entirely divested of those parental solicitudes which so strongly mark the manners of the more perfect terrestrial animals. How far they copulate,

remains as yet a doubt; for though they seem to join, yet the male is not furnished with any external instrument of generation. It is said by some, that his only end in that action is to emit his impregnating milt upon the eggs that at that time fall from the female. He is said to be seen pursuing them as they float down the stream, and carefully impregnating them one after another. On some occasions also the females dig holes in the bottom of rivers and ponds, and there deposit their spawn, which is impregnated by the male in the same manner. All this, however, is very doubtful: what we know with certainty of the matter, and that not discovered till very lately, is, that the male has two organs of generation that open into the bladder of urine, and that these organs do not open into the rectum as in birds, but have a peculiar aperture of their own *. These organs of generation in the male are empty at some seasons of the year; but before the time of spawning they are turgid with what is called the milt, and emit the fluid proper for impregnation.

Fish have different seasons for depositing their spawn: some, that live in the depths of the ocean, are said to choose the winter months; but, in general, those with which we are acquainted choose the hottest months in summer, and prefer such water as is somewhat tepified by the beams of the sun. They then leave the deepest parts of the ocean, which are the coldest, and shoal round the coasts, or swim up the fresh water rivers, which are warm as they are comparatively shallow. When they have deposited their burdens, they then return to their old stations, and leave their nascent progeny to shift for themselves.

The spawn continues in its egg state in some fish longer than in others, and this in proportion to the animal's size. In the salmon, for instance, the young animal continues in the egg from the beginning of December till the beginning of April; the carp continues in the egg not above three weeks; the little gold-fish from China is produced still quicker. These all, when excluded, at first escape by their minuteness and agility. They rise, sink, and turn much readier than grown fish; and they can escape into very shallow waters when pursued. But, with all their advantages, scarcely one in a thousand survives the numerous perils of its youth. The very male and female that have given them birth, are equally dangerous and formidable with the rest, forgetting all relation at their departure.

Such is the general picture of these heedless and hungry creatures: but there are some in this class living in the waters, that are possessed of finer organs and higher sensations; that have all the tenderness of birds or quadrupeds for their young; that nurse them with constant care, and protect them from every injury. Of this class are the *Cetaceous* tribe, or the fishes of the whale kind. There are others, though not capable of nursing their young, yet

* *Vide* Gaman de Generatione Piscium.

JOHN DOREE

DRAGONET

that bring them alive into the world, and defend them with courage and activity. These are the *Cartilaginous* kinds, or those who have gristles instead of bones. But the fierce unmindful tribe we have been describing, that leave their spawn without any protection, are called *Spinous* or bony kinds, from their bones resembling the sharpness of thorns.

Thus there are three grand divisions in the fish kind; the *cetaceous*, the *cartilaginous*, and the *spinous;* all differing from each other in their conformation, their appetites, in their bringing forth, and in the education of their young. These three great distinctions are not the capricious differences formed by a maker of systems, but are strongly and firmly marked in nature. These are the distinctions of Aristotle; and they have been adopted by mankind ever since his time. It will be necessary, therefore, to give the history of each of these in particular; and then to range, under each head, those fishes whose history is the most remarkable, or, more properly speaking, those of which we have any history. For we shall find, when we come to any of the species in particular, how little can be said of their habits, their stations, or method of propagation.

Much, indeed, can be said of them, if considered relatively to man; and large books have been written of the manner of taking fish, or of dressing them. Apicius is noted for having first taught mankind to suffocate fish in Carthaginian pickle, and Quin for giving a sauce to the John-dory; Mrs. Glasse is famous for the eel-pie, and Mr. Tull for his invention of spaying carp to give it a finer flavour. In this manner our cooks handle the subject. On the other hand, our physicians assure us that the flesh of fishes yields little nourishment, and soon corrupts; that it abounds in a gross sort of oil and water, and hath but few volatile particles, which renders it less fit to be converted into the substance of our bodies. They are cold and moist, and must needs, say they, produce juices of the same kind, and consequently are improper to strengthen the body. In this diversity of opinion, it is the wisest way to eat our fish in the ordinary manner, and pay no great attention to cooks or doctors.

I cannot conclude this chapter without putting a question to the learned, which I confess, I am not able to resolve. How comes it that fish, which are bred in a salt element, have yet no salt to the taste, or that is capable of being extracted from them?

CHAPTER II.

OF CETACEOUS FISHES IN GENERAL.

As on land there are some orders of animals that seem formed to command the rest, with greater powers and more various instincts, so in the ocean there are fishes which seem formed upon a nobler plan than others, and that, to their fishy form, join the appetites and the conformation of quadrupeds. These are all of the *cetaceous* kind; and so much raised above their fellows of the deep, in their appetites and instincts, that almost all our modern naturalists have fairly excluded them from the finny tribes, and will have them called, not fishes, but great beasts of the ocean. With them, it would be as improper to say men go to Greenland fishing for whale, as it would be to say that a sportsman goes to Blackwall a-fowling for mackerel.

Yet, notwithstanding philosophers, mankind will always have their own way of talking; and, for my own part, I think them here in the right. A different formation of the lungs, stomach, and intestines, a different manner of breathing or propagating, are not sufficient to counterbalance the great obvious analogy which these animals bear to the whole finny tribe. They are shaped as other fishes; they swim with fins; they are entirely naked, without hair; they live in the water, though they come up to breathe; they are only seen in the depths of the ocean, and never come upon shore but when forced thither. These sure are sufficient to plead in favour of the general denomination, and acquit mankind of error in ranking them with their lower companions of the deep.

But still they are as many degrees raised above other fishes in their nature, as they are in general in their size. This tribe is composed of the Whale and its varieties, of the Cachalot, the Dolphin, the Grampus, and the Porpoise. All these resemble quadrupeds in their internal structure, and in some of their appetites and affections. Like quadrupeds, they have lungs, a midriff, a stomach, intestines, liver, spleen, bladder, and parts of generation: their heart also resembles that of quadrupeds, with its partitions closed up as in them, and driving red and warm blood in circulation through the body. In short, every internal part bears a most striking similitude; and to keep these parts warm, the whole kind are also covered between the skin and the muscles with a thick coat of fat or blubber, which, like the bacon-fat of a hog, keeps out the cold, renders their muscles glib and pliant, and probably makes them lighter in swimming.

As these animals breathe the air, it is obvious that they cannot bear to be any long time under water. They are constrained, therefore, every two or three minutes, to come up to the surface to take breath, as well as to spout out through their nostril, for they have but one, that water which they sucked in while gaping for

their prey. This conduit, by which they breathe, and also throw out the water, is placed in the head, a little before the brain. Though externally the hole is but single, it is internally divided by a bony partition, which is closed by a sphincter muscle on the inside, that, like the mouth of a purse, shuts it up at the pleasure of the animal. There is also another muscle or valve, which prevents the water from going down the gullet. When therefore the animal takes in a certain quantity of water, which is necessary to be discharged and separated from its food, it shuts the mouth, closes the valve of the stomach, opens the sphincter that kept the nostril closed, and then breathing strongly from the lungs, pushes the water out by the effort, as we see it rise by the pressure of air in a fire-engine.

The senses of these animals seem also superior to those of other fishes. The eyes of other fishes, we have observed, are covered only with that transparent skin that covers the rest of the head; but in all the cetaceous kinds it is covered by eye-lids, as in man. This, no doubt, keeps that organ in a more perfect state, by giving it intervals of relaxation, in which all vision is suspended. The other fishes, that are for ever staring, must see, if for no other reason, more feebly, as their organs of sight are always exerted.

As for hearing, these also are furnished with the internal instruments of the ear, although the external orifice nowhere appears. It is most probable that this orifice may open by some canal, resembling the Eustachian tube, into the mouth; but this has not as yet been discovered.

Yet nature sure has not thus formed a complete apparatus for hearing, and denied the animal the use of it when formed. It is most likely that all animals of the cetaceous kind can hear, as they certainly utter sounds, and bellow to each other. This vocal power would be as needless to animals naturally deaf, as glasses to a man that was blind.

But it is in the circumstances in which they continue their kind, that these animals show an eminent superiority. Other fish deposit their spawn, and leave the success to accident; these never produce above one young, or two at the most; and this the female suckles entirely in the manner of quadrupeds, her breasts being placed, as in the human kind, above the navel. We have read many fabulous accounts of the nursing of the demi-gods of antiquity, of their feeding on the marrow of lions, and their being suckled by wolves; one might imagine a still more heroic system of nutrition, if we supposed that the young hero was suckled and grew strong upon the breast milk of a she-whale!

The whale or the grampus are terrible at any time, but are fierce and desperate in the defence of their young. In Waller's beautiful poem of the Summer Islands, we have a story, founded upon fact, which shows the maternal tenderness of these animals for their offspring. A whale and her cub had got into an arm of the sea, where, by the desertion of the tide, they were enclosed

on very side. The people from shore soon saw their situation, and drove down upon them in boats, with such weapons as the urgent occasion offered. The two animals were soon wounded in several places, and the whole sea round was tinctured with their blood. The whales made several attempts to escape; and at last the old one, by its superior strength, forced over the shallow into the depths of the ocean. But though in safety herself, she could not bear the danger that awaited her young one; she therefore rushed in once more where the smaller animal was imprisoned, and resolved, when she could not protect, at least to share its danger. The story ends with poetical justice; for the tide coming in, brought off both in safety from their enemies, though not without sustaining an infinite number of wounds in every part.

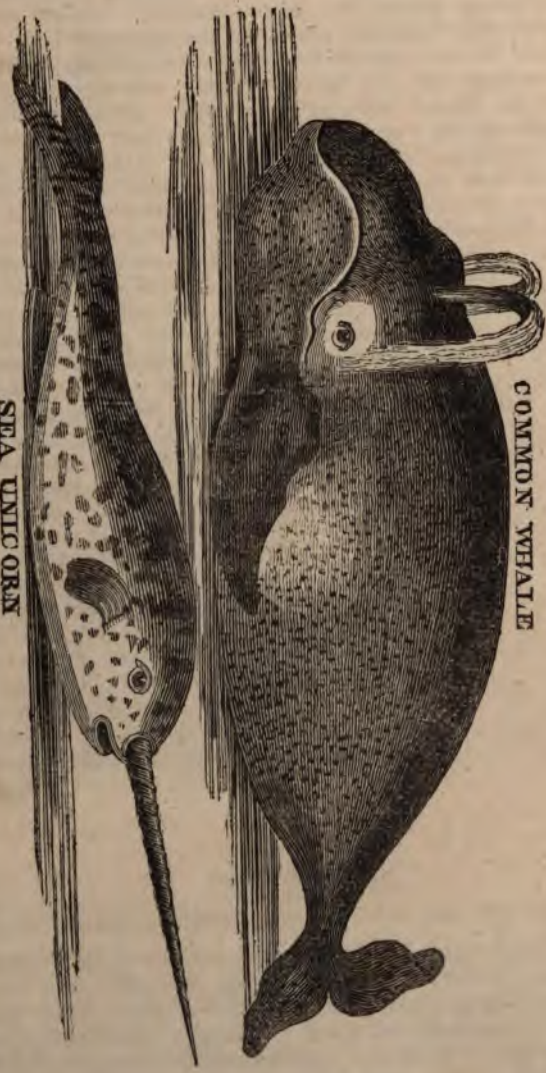
As to the rest, the distinctive marks of this tribe are, that the number of their fins never exceed three; namely, two pectoral fins, and one back fin; but in some sorts the last is wanting. These fins differ very much from those of other fishes, which are formed of straight spines: the fins of the cetaceous tribe are made up of bones and muscles; and the skeleton of one of their fins very much resembles the skeleton of a man's hand. Their tales also are different from those of all other fish: they are placed so as to lie flat on the surface of the water; while the other kinds have them, as we every day see, upright or edgeways. This flat position of the tail in cetaceous animals, enables them to force themselves suddenly to the surface of the water to breathe, which they are continually constrained to do.

Of these enormous animals some are without teeth, and properly called whales; others have the teeth only in the lower jaw, and are called, by the French, cachalots; the narwhal has teeth only in the upper jaw; the dolphin's teeth, as well as those of the porpoise and grampus, are both above and below. These are the marks that serve to distinguish the kinds of this enormous tribe from each other, and these shall serve to guide us in giving their history.

CHAPTER III.

OF THE WHALE, PROPERLY SO CALLED, AND ITS VARIETIES.

If we compare land animals, in respect to magnitude, with those of the deep, they will appear contemptible in the competition. It is probable, indeed, that quadrupeds once existed much larger than we find them at present. From the skeletons of some that have been dug up at different times, it is evident, that there must have been terrestrial animals twice as large as the elephant; but creatures of such an immense bulk required a proportionable extent of ground for subsistence, and, by being rivals with men for large territory, they must have been destroyed in the contest.



COMMON WHALE

SEA UNICORN

But it is not only upon land that man has exerted his power of destroying the larger tribes of animated nature; he has extended his efforts even in the midst of the ocean, and has cut off numbers of those enormous animals that had perhaps existed for ages. We now no longer hear of whales two hundred and two hundred and fifty feet long, which we are certain were often seen about two centuries ago. They have all been destroyed by the skill of mankind, and the species is now dwindled into a race of diminutive animals, from thirty to about eighty feet long.

The northern seas were once the region to which the greatest of these animals resorted; but so great has been the slaughter of whales for more than two ages, that they begin to grow thinner every day, and those that are found there seem, from their size, not come to their full dimensions. The greatest whales resort to places where they have the least disturbance; to those seas that are on the opposite side of the globe, near the south pole. In that part of the world there are still to be seen whales that are above a hundred and sixty feet long; and perhaps even longer might be found in those latitudes near the south pole, to which we have not as yet ventured.

Taking the whale, however, at the ordinary size of eighty feet long and twenty feet high, what an enormous animated mass must it appear to the spectator! With what amazement must it strike him to behold so great a creature gambolling in the deep with the ease and agility of the smallest animal, and making its way with incredible swiftness! This is a sight which is very common to those who frequent the northern or southern ocean. Yet though this be wonderful, perhaps still greater wonders are concealed in the deep, which we have not had opportunities of exploring. These large animals are obliged to shew themselves in order to take breath; but who knows the size of those that are fitted to remain for ever under-water, and that have been increasing in magnitude for centuries? To believe all that has been said of the sea serpent, or the Kraken, would be credulity; to reject the possibility of their existence, would be presumption.

The whale is the largest animal of which we have any certain information, and the various purposes to which, when taken, its different parts are converted, have brought us tolerably acquainted with its history. Of the whale, properly so called, there are no less than seven different kinds, all distinguished from each other by their external figure or internal conformation. The Great Greenland Whale, without a back-fin, and black on the back; the Iceland Whale, without a back-fin, and whitish on the back; the New-England Whale, with a hump on the back; the Whale, with six humps on the back; the Fin-fish, with a fin on the back near the tail; the Pike-headed Whale, and the Round-lipped Whale. All these differ from each other in figure, as their names obviously imply. They differ also in their manner of living; the fin-fish having a larger swallow than the rest, being more

active, slender, and fierce, and living chiefly upon herrings. However, they are none of them very voracious; and if compared to the Cachalot, that enormous tyrant of the deep, they appear harmless and gentle. The history of the rest, therefore, may be comprised under that of the great common Greenland whale, with which we are best acquainted.

The Great Greenland Whale is the fish, for taking which there are such preparations made in different parts of Europe. It is a large heavy animal, and the head alone makes a third of its bulk. It is usually found from sixty to seventy feet long. The fins on each side are from five to eight feet, composed of bones and muscles, and sufficiently strong to give the great mass of body which they move, speed and activity. The tail, which lies flat on the water, is above twenty-four feet broad, and, when the fish lies on one side, its blow is tremendous. The skin is smooth and black, and in some places marbled with white and yellow, which, running over the surface, has a very beautiful effect. This marbling is particularly observable in the fins and the tail. In the figures which are thus drawn by nature, fancy often forms the pictures of trees, landscapes, and houses. In the tail of one that was thus marbled, Ray tells us that the number 122 was figured very evenly and exact, as if done with a pencil.

The whale makes use only of the tail to advance itself forward in the water. This serves as a great oar to push its mass along; and it is surprising to see with what force and celerity its enormous bulk cuts through the ocean. The fins are only made use of for turning in the water, and giving a direction to the velocity impressed by the tail. The female also makes use of them when pursued to bear off her young, clapping them on her back, and supporting them by the fins on each side from falling.

The outward or scarf skin of the whale is no thicker than parchment; but this removed, the real skin appears, of about an inch thick, and covering the fat or blubber that lies beneath: this is from eight to twelve inches in thickness, and is, when the fish is in health, of a beautiful yellow. The muscles lie beneath, and these, like the flesh of quadrupeds, are very red and tough.

The cleft of the mouth is above twenty feet long, which is near one third of the animal's whole length; and the upper jaw is furnished with barbs, that lie like the pipes of an organ, the greatest in the middle, and the smallest to the sides. These compose the whalebone, the longest spars of which are found to be not less than eighteen feet; the shortest, being of no value, are thrown away. The tongue is almost immoveably fixed to the lower jaw, seeming one great lump of fat; and in fact it fills several hogsheads with blubber. The eyes are not larger than those of an ox; and when the crystalline humour is dried, it does not appear larger than a pea. They are placed towards the back of the head, being the most convenient situation for enabling them to see both before and behind, as also to see over them, where their food is principally

found. They are guarded by eye-lids and eye-lashes, as in quadrupeds; and they seem to be very sharp-sighted.

Nor is their sense of hearing in less perfection, for they are warned at great distances of any danger preparing against them. It would seem as if nature had designedly given them these advantages, as they multiply little, in order to continue their kind. It is true, indeed, that the external organ of hearing is not perceptible, for this might only embarrass them in their natural element; but as soon as the thin scarf-skin above-mentioned is removed, a black spot is discovered behind the eye, and under that is the auditory canal, that leads to a regular apparatus for hearing. In short, the animal hears the smallest sounds at very great distances, and at all times, except when it is spouting water, which is the time that the fishers approach to strike it.

These spout-holes or nostrils, in all the cetaceous tribe, have been already described: in this whale there are two, one on each side the head before the eyes, and crooked somewhat like the holes on the belly of a violin. From these holes this animal blows the water very fiercely, and with such a noise that it roars like a hollow wind, and may be heard at three miles distance. When wounded, it then blows more fiercely than ever, so that it sounds like the roaring of the sea in a great storm.

We have already observed, that the substance called whalebone is taken from the upper jaw of the animal, and is very different from the real bones of the whale. The real bones are hard, like those of great land animals, are very porous, and filled with marrow. Two great strong bones sustain the under lip, lying against each other in the shape of a half-moon; some of these are twenty feet long: they are seen in several gardens, set up against each other, and are usually mistaken for the ribs of this animal.

Such is the general conformation and figure of this great inhabitant of the deep, the precise anatomy of which has not been yet ascertained. In those places where they are caught in greatest abundance, the sailors are not very curious as to the structure of the viscera; and few anatomists care to undertake a task, where the operator, instead of separating with a lancet, must cut his way with an axe. It is as yet doubted, therefore, whether the whale, that in most points internally resembles a quadruped, may not have one great bowel fitted entirely for the reception of air, to supply it when constrained to keep longer than usual at the bottom. The sailors universally affirm that it has; and philosophers have nothing but the analogy of its parts to oppose to their general assertions.

As these animals resemble quadrupeds in conformation, so they bear a strong resemblance in some of their appetites and manners. The female joins with the male, as is asserted, *more humano*, and once in two years feels the accesses of desire.

Their fidelity to each other exceeds whatever we are told of even the constancy of birds. Some fishers, as Anderson informs us, having struck one of two whales, a male and a female, that were

in company together, the wounded fish made a long and a terrible resistance: it struck down a boat with three men in it, with a single blow of the tail, by which all went to the bottom. The other still attended its companion, and lent it every assistance, till at last the fish that was struck sunk under the number of its wounds, while its faithful associate, disdaining to survive the loss, with great bellowing stretched itself upon the dead fish, and shared its fate.

The whale goes with young nine or ten months, and is then fatter than usual, particularly when near the time of bringing forth. It is said that the embryo, when first perceptible, is about seventeen inches long, and white; but the cub, when excluded, is black, and about ten feet long. She generally produces one young one, and never above two. When she suckles her young, she throws herself on one side on the surface of the sea, and the young one attaches itself to the teat. The breasts are two, generally hid within the belly; but she can produce them at pleasure, so as to stand forward a foot and a half or two feet; and the teats are like those of a cow. In some the breasts are white; in others speckled; in all filled with a large quantity of milk, resembling that of land animals.

Nothing can exceed the tenderness of the female for her offspring; she carries it with her wherever she goes, and when hardest pursued, keeps it supported between her fins. Even when wounded, she still clasps her young one; and when she plunges to avoid danger, takes it to the bottom, but rises sooner than usual, to give it breath again.

The young ones continue at the breast for a year, during which time they are called by the sailors *short-heads*. They are then extremely fat, and yield above fifty barrels of blubber. The mother, at the same time, is equally lean and emaciated. At the age of two years they are called *stunts*, as they do not thrive much immediately after quitting the breast; they then scarce yield above twenty, or twenty-four barrels of blubber: from that time forward they are called *skull-fish*, and their age is wholly unknown.

Every species of whale propagates only with those of its own kind, and does not at all mingle with the rest: however, they are generally seen in shoals of different kinds together, and make their migrations in large companies from one ocean to another. They are a gregarious animal, which implies their want of mutual defence against the invasions of smaller, but more powerful fishes. It seems astonishing, therefore, how a shoal of these enormous animals find subsistence together, when it would seem that the supplying even one with food would require greater plenty than the ocean could furnish. To increase our wonder, we not only see them herding together, but usually find them fatter than any other animals of whatsoever element. We likewise know that they cannot swallow large fishes, as their throat is so narrow, that an animal larger than a herring could not enter. How then do they subsist

and grow so fat? A small insect which is seen floating in those seas, and which Linnæus terms the *Medusa*, is sufficient for this supply. These insects are black, and of the size of a small bean, and are sometimes seen floating in clusters on the surface of the water. They are of a round form, like snails in a box, but they have wings, which are so tender that it is scarcely possible to touch them without breaking. These serve rather for swimming than flying; and the little animal is called by the Icelanders the *Walfishchoas*, which signifies the whale's provender. They have the taste of raw muscles, and have the smell of burnt sugar. These are the food of the whale, which it is seen to draw up in great numbers with its huge jaws, and to bruise between its barbs, which are always found with several of these sticking among them.

This is the simple food of the great Greenland whale; it pursues no other animal, leads an inoffensive life in its element, and is harmless in proportion to its strength to do mischief. There seems to be an analogy between its manners and those of the elephant. They are both the strongest and the largest animals in their respective elements; neither offer injury, but are terrible when provoked to resentment. The fin-fish indeed, in some measure differs from the great whale in this particular, as it subsists chiefly upon herrings, great shoals of which it is often seen driving before it. Yet even the swallow of this fish is not very large, if compared to the cachalot tribe, and its ravages are but sports in comparison. The stomach and intestines of all these animals, when opened, seldom have any thing in them except a soft unctuous substance, of a brownish colour; and their excrements are of a shining red.

As the whale is an inoffensive animal, it is not to be wondered that it has many enemies, willing to take advantages of its disposition and inaptitude for combat. There is a small animal, of the shell-fish kind, called the Whale-louse, that sticks to its body, as we see shells sticking to the foul bottom of a ship. This insinuates itself chiefly under the fins; and whatever efforts the great animal makes, it still keeps its hold, and lives upon the fat, which it is provided with instruments to arrive at.

The sword-fish, however, is the whale's most terrible enemy. "At the sight of this little animal," says Anderson, "the whale seems agitated in an extraordinary manner, leaping from the water as if with affright: wherever it appears, the whale perceives it at a distance, and flies from it in the opposite direction. I have been myself," continues he, "a spectator of their terrible encounter. The whale has no instrument of defence except the tail: with that it endeavours to strike the enemy; and a single blow taking place would effectually destroy its adversary: but the sword-fish is as active as the other is strong, and easily avoids the stroke; then bounding into the air, it falls upon its great subjacent enemy, and endeavours not to pierce with its pointed beak, but to cut it with its toothed edges. The sea all about is soon dyed with blood,

proceeding from the wounds of the whale; while the enormous animal vainly endeavours to reach its invader, and strikes with its tail against the surface of the water, making a report at each blow louder than the noise of a cannon."

There is still another and more powerful enemy, called by the fisherman of New England the *Killer*. This is itself a cetaceous animal, armed with strong and powerful teeth. A number of these are said to surround the whale, in the same manner as dogs get round a bull. Some attack it with their teeth behind, others attempt it before, until at last the great animal is torn down, and its tongue is said to be the only part they devour when they have made it their prey. They are said to be of such great strength, that one of them alone was known to stop a dead whale that several boats were towing along, and drag it from among them to the bottom.

But of all the enemies of these enormous fishes, man is the greatest: he alone destroys more in a year than the rest in an age, and actually has thinned their numbers in that part of the world where they are chiefly sought. The great resort of these animals was found to be on the inhospitable shores of Spitzbergen; where the distance of the voyage, the coldness of the climate, the terrors of the Icy Sea, and still more, their own formidable bulk, might have been expected to protect them from human injury. But all these were but slight barriers against man's arts, his courage, and his necessities. The European ships, soon after the improvement of navigation, found the way into those seas, and as early as the beginning of the fourteenth century, the Biscayneers were in possession of a very considerable trade to the coasts of Greenland. The Dutch and the English followed them thither, and soon took that branch of commerce out of their hands. The English commenced the business about the beginning of the seventeenth century; and the town of Hull had the honour of first attempting that profitable branch of trade. But at present it seems upon the decline, as the quantity of fish are so greatly reduced by the constant capture for such a vast length of time. It is now said, that the fishers, from a defect of whales, apply themselves to the seal-fishery; yet, as these animals are extremely timorous, they will soon be induced to quit those shores where they meet such frequent disturbance and danger. The poor natives of Greenland themselves, who used to feed upon the whale, are diminishing in proportion as their sustenance is removed; and it is probable that the revolution of a few years will see that extensive coast totally deserted by its inhabitants, as it is already nearly deserted by the whales.

The art of taking whales, like most others, is much improved by time, and differs in many respects from that practised by the Biscayneers when they first frequented the Icy Sea. But as the description of their methods is the least complicated, and consequently the easiest understood, it will be best suited to our purpose,

For this navigation, the Biscayneers, in favourable seasons, fitted out thirty ships, of two hundred and fifty tons each, with fifty choice men a-piece, and a few boys. These were stored with six months' provision; and each ship had its boats, which were to be serviceable when come to the place of duty. When arrived at the part where the whales are expected to pass to the southward, they always keep their sails set, and a sailor is placed at the mast-head to give information when he spies a whale. As soon as he discovers one, the whole crew are instantly in employment; they fit out their boats, and row away to where the whale was seen. The harpooner, who is to strike the fish, stands at the prow of the boat, with a harpoon or javelin in his hand, five or six feet long, pointed with steel like the barb of an arrow, of a triangular shape. As this person's place is that of the greatest dexterity, so also is it of the greatest danger: the whale sometimes overturns the boat with a blow of its tail, and sometimes drives against it with fury. In general, however, the animal seems to sleep on the surface of the water: while the boat is approaching, the harpooner stands aloft, and, with his harpoon tied to a cord of several hundred fathoms length, darts it into the animal, and then rows as fast as possible away. It is some time before the whale seems to feel the blow; the instrument has usually pierced no deeper than the fat, and that being insensible, the animal continues for a while motionless; but soon roused from its seeming lethargy, as the shaft continues to pierce deeper and deeper into the muscular flesh, it flies off with amazing rapidity. In the mean time, the harpoon sticks in its side; while the rope which is coiled up in the boat, and runs upon a swivel, lengthens as the whale recedes, but still shows the part of the deep to which it has retreated. The cord is coiled up with great care; for such is the rapidity with which it runs off, that if it was but in the least checked, as it yields with the animal's retreat, it would infallibly overset the boat, and the crew would go to the bottom. It sometimes happens also, that the rapidity with which it runs over the swivel at the edge of the boat, heats it, and it would infallibly take fire, did not a man stand continually with a wet mop in his hand to cool the swivel as the cord runs. The whale having dived to a considerable depth, remains at the bottom, sometimes for near half an hour, with the harpoon in its body, and then rises to take breath, expecting the danger over; but the instant it appears, they are all with their boats ready to receive it, and fling their harpoons into its body: the animal again dives and again rises, while they repeat their blows. The ship follows in full sail, like all the rest, never losing sight of the boats, and ready to lend them assistance: the whole ocean seems dyed in blood. Thus they renew their attack, till the whale begins to be quite enfeebled and spent, when they plunge their longer spears into various parts of its body, and the enormous animal expires. When it is dead, to prevent it from sinking, they tie it with a strong iron chain to the boat, and either cut it up in

pieces, and carry it home in that manner, or extract the oil from the blubber on ship-board.

Such is the manner in which these fish were taken in the beginning: but succeeding arts have improved the method, and the harpoon is now thrown by; a machine being used which inflicts a deeper wound, and strikes the animal with much greater certainty. There are better methods for extracting the oil, and more proper machines for cutting the animal up, than were used in the early fisheries. But as an account of this belongs to the history of art and not of nature, we must be contented with observing, that several parts of this animal, and all but the intestines and the bones, are turned to very good account; not only the oil, but the greaves from which it is separated. The barbs also were an article of great profit; but have sunk in their price since women no longer use them to swell out their petticoats with whalebone. The flesh of this animal is also a dainty to some nations; and even the French seamen are now and then found to dress and use it as their ordinary diet at sea. It is said by the English and Dutch sailors to be hard and ill-tasted, but the French assert the contrary; and the savages of Greenland, as well as those near the south pole, are fond of it to distraction. They eat the flesh, and drink the oil, which is a first-rate delicacy. The finding a dead whale is an adventure considered among the fortunate circumstances of their wretched lives. They make their abode beside it; and seldom remove till they have left nothing but the bones.

Jacobson, whom we quoted before in the History of Birds, where he describes his countrymen of the Island of Eeroe as living a part of the year upon salted gulls, tells us also, that they are very fond of salted whales' flesh. The fat of the head they season with bay salt, and then hang it up to dry in the chimney. He thinks it tastes as well as fat bacon; and the lean, which they boil, is, in his opinion, not inferior to beef.—I fancy poor Jacobson would make but an indifferent taster at one of our city feasts!

CHAPTER IV.

OF THE NARWHAL.

From whales that entirely want teeth, we come to such as have them in the upper jaw only; and in this class there is found but one, the Narwhal, or Sea-Unicorn. This fish is not so large as the whale, not being above sixty feet long. Its body is slenderer than that of the whale, and its fat not in so great abundance. But this great animal is sufficiently distinguished from all others of the deep by its tooth or teeth, which stand pointing directly forward from the upper jaw, and are from nine to fourteen feet long. In all the variety of weapons with which nature has armed her various tribes, there is not one so large or so formidable as this. This

terrible weapon is generally found single, and some are of opinion that the animal is furnished but with one by nature; but there is at present the skull of a narwhal at the Stadthouse at Amsterdam with two teeth, which plainly proves that in some animals at least this instrument is double. It is even a doubt whether it may not be so in all, and that the narwhal's wanting a tooth is only an accident which it has met with in the encounters it is obliged daily to be engaged in. Yet it must be owned, of those that are taken only with one tooth, that there seems no socket, nor no remains of any other upon the opposite side of the jaw, but all is plain and even. However this be, the tooth, or as some are pleased to call it, the horn of the narwhal, is the most terrible of all natural instruments of destruction. It is as straight as an arrow, about the thickness of the small of a man's leg, wreathed in the manner we sometimes see twisted bars of iron; it tapers to a sharp point; and is whiter, heavier, and harder than ivory. It is generally seen to spring from the left side of the head directly forward in a straight line with the body; and its root enters into the socket above a foot and a half. In a skull to be seen at Hamburgh there are two teeth, which are each above seven feet long, and are eight inches in circumference. When the animal possessed of these formidable weapons, is urged to employ them, it drives directly forward against the enemy with its teeth, that, like protended spears, pierce whatever stands before them.

The extreme length of these instruments has induced some to consider them rather as horns than teeth, but they in every respect resemble the tusks of the boar and the elephant. They grow, as in them, from sockets in the upper jaw; they have the solidity of the hardest bone, and far surpass ivory in all its qualities. The same error has led others to suppose, that as among quadrupeds the female was often found without horns, so these instruments of defence were only to be found in the male; but this has been more than once refuted by actual experience; both sexes are found armed in this manner: the horn is sometimes found wreathed and sometimes smooth, sometimes a little bent and sometimes strait, but always strong, deeply fixed, and sharply pointed.

Yet notwithstanding all these appointments for combat, these long and pointed tusks, amazing strength, and unmatchable celerity, the narwhal is one of the most harmless and peaceable inhabitants of the ocean. It is seen constantly and inoffensively sporting among the other great monsters of the deep, no way attempting to injure them, but pleased in their company. The Greenlanders call the narwhal the forerunner of the whale; for wherever it is seen, the whale is shortly after sure to follow. This may arise as well from the natural passion for society in these animals, as from both living upon the same food, which are the insects described in the preceding chapter. These powerful fishes make war upon no other living creature; and though furnished with instruments to spread general destruction, are as innocent and as peaceful as a drove of oxen.

Nay, so regardless are they of their own weapons, and so utterly unmindful to keep them in repair for engagement, that they are constantly seen covered over with weeds, slough, and all the filth of the sea; they seem rather considered as an impediment than a defence.

The manners and appetites both of the narwhal and the great whale are entirely similar; they both alike want teeth for chewing, and are obliged to live upon insects; they both are peaceable and harmless, and always rather fly than seek the combat. The narwhal, however, has a much narrower gape than the great whale, and therefore does not want the use of barbs to keep in its food when once sucked into the mouth. It is also much swifter, and would never be taken by the fisherman but for those very tusks, which at first appear to be its principal defence. These animals, as was said, being fond of living together, are always seen in herds of several at a time; and whenever they are attacked, they crowd together in such a manner that they are mutually embarrassed by their tusks. By these they are often locked together, and are prevented from sinking to the bottom. It seldom happens, therefore, but the fishermen make sure of one or two of the hindmost, which very well reward their trouble.

It is from the extraordinary circumstance of the teeth, therefore, that this fish demands a distinct history; and such has been the curiosity of mankind, and their desire to procure them, that a century ago they were considered as the greatest rarity in the world. At that time the art of catching whales was not known, and mankind saw few, except such as were stranded on the coasts by accident. The tooth of the narwhal, therefore, was ascribed to a very different animal from that which really bore it. Among other fossil substances they were sometimes dug up; and the narwhal being utterly unknown, naturalists soon found a terrestrial owner. They were thought to be the horns of unicorns, an animal described by Pliny as resembling a horse, and with one straight horn darting forward from the middle of its forehead. These teeth were therefore considered as a strong testimony in favour of that historian's veracity, and were shown among the most precious remains of antiquity. Even for some time after the narwhal was known, the deceit was continued, as those who were possessed of a tooth sold it to great advantage. But at present they are too well known to deceive any, and are only shown for what they really are; their curiosity increasing in proportion to their weight and their size.

CHAPTER V.

OF THE CACHALOT AND ITS VARIETIES.

THE Cachalot, which has generally gone under the name of the Spermaceti Whale, till Mr. Pennant very properly made the distinction by borrowing its name from the French, has several teeth in the under jaw, but none in the upper. As there are no less than seven distinctions among whales, so also there are the same number of distinctions in the tribe we are describing. The cachalot with two fins and a black back; the cachalot with too fins and a whitish back; that with a spout in the neck; that with a spout in the snout; that with three fins and sharp-pointed teeth; that with three fins and sharp-edged teeth; and, lastly, the cachalot with three fins and flatted teeth.

This tribe is not of such enormous size as the whale, properly so called, not being above sixty feet long, and sixteen feet high. In consequence of their being more slender, they are much more active than the common whale; they remain a longer time at the bottom, and afford a smaller quantity of oil. As in the common whale the head was seen to make a third part of its bulk, so in this species the head is so large as to make one-half of the whole. The tongue of this animal is small, but the throat is very formidable, and with very great ease it could swallow an ox. In the stomach of the whale scarcely any thing is to be found, but in that of the cachalot there are loads of fish of different kinds; some whole, some half digested, some small, and others eight or nine feet long. The cachalot is therefore as destructive among lesser fishes as the whale is harmless, and can at one gulp swallow a shoal of fishes down its enormous gullet. Linnæus tells us that this fish pursues and terrifies the dolphins and porpoises so much as often to drive them on shore.

But how formidable soever this fish may be to its fellows of the deep, it is by far the most valuable, and the most sought after by man, as it contains two very precious drugs, spermaceti and ambergris. The use of these, either for the purposes of luxury or medicine, is so universal, that the capture of this animal, that alone supplies them, turns out to very great advantage, particularly since the art has been found out of converting all the oil of this animal, as well as the brain, into that substance called spermaceti.

This substance, as it is naturally formed, is found in the head of the animal, and is no other than the brain. The outward skin of the head being taken off, a covering of fat offers about three inches thick; and under that, instead of a bony skull, the animal has only another thick skin, that serves for a covering and defence of the brain. The first cavity or chamber of the brain, is filled with that spermaceti which is supposed of the greatest purity and highest value. From this cavity there is generally drawn about

seven barrels of the clearest spermaceti, that, thrown upon water, coagulates like cheese. Below this there is another chamber just over the gullet, which is about seven feet high; and this also contains the drug, but of less value. It is distributed in this cavity like honey in a hive, in small cells separated from each other by a membrane like the inner skin of an egg. In proportion as the oily substance is drawn away from this part, it fills anew from every part of the body; and from this is generally obtained about nine barrels of oil. Besides this, the spinal marrow, which is about as thick as a man's thigh, and reaches all along the back-bone to the tail, where it is not thicker than one's finger, affords no inconsiderable quantity.

This substance, which is used in the composition of many medicines rather to give them consistency than efficacy, was at first sold at a very high price, both from the many virtues ascribed to it, and the small quantity that the cachalot was capable of supplying: at present the price is greatly fallen; first, because its efficacy in medicine is found to be very small; and again, because the whole oil of the fish is very easily convertible into spermaceti. This is performed by boiling it with a ley of potash, and hardening it in the manner of soap. Candles are now made of it, which are substituted for wax, and sold much cheaper; so that we need not fear having our spermaceti adulterated in the manner some medical books caution us to beware of, for they carefully guard us against having our spermaceti adulterated with virgin wax.

As to the ambergris, which is sometimes found in this whale, it was long considered as a substance found floating on the surface of the sea; but time, that reveals the secrets of the mercenary, has discovered that it chiefly belongs to this animal. The name which has been improperly given to the former substance, seems more justly to belong to this, for the ambergris is found in the place where the seminal vessels are usually situated in other animals. It is found in a bag of three or four feet long, in round lumps, from one to twenty pounds weight, floating in a fluid rather thinner than oil, and of a yellowish colour. There are never seen more than four at a time in one of these bags; and that which weighed twenty pounds, and which was the largest ever seen, was found single. These balls of ambergris are not found in all fishes of this kind, but chiefly in the oldest and strongest. The uses of this medicine for the purposes of luxury and as a perfume are well known, though upon some subjects ignorance is preferable to information. *

[* As ambergris has not been found in any whales but such as are dead or sick, its production is generally supposed to be owing to disease, though some have a little too peremptorily affirmed it to be the cause of the morbid affection. No large piece having ever been found without a greater or less quantity of the beaks of the *sepia octopodia* (the common food of the spermaceti whale) interspersed throughout its substance, there can be little doubt of its originating in the intestines of the whale.—URE'S *Dictionary of Chemistry*.—AMBERGRIS.]

CHAPTER VI.

OF THE DOLPHIN, THE GRAMPUS, AND THE PORPOISE, WITH THEIR VARIETIES.

All these fish have teeth both in the upper and the lower jaw, and are much less than the whale. The Grampus, which is the largest, never exceeds twenty feet. It may also be distinguished by the flatness of its head, which resembles a boat turned upside down. The Porpoise resembles the grampus in most things except the snout, which is not above eight feet long; its snout also more resembles that of a hog. The Dolphin has a strong resemblance to the porpoise, except that its snout is longer and more pointed. They have all fins on the back; they all have heads very large, like the rest of the whale kind; and resemble each other in their appetites, their manners, and conformation, being equally voracious, active, and roving.

The great agility of these animals prevents their often being taken. They seldom remain a moment above water: sometimes, indeed, their too eager pursuits expose them to danger; and a shoal of herrings often allures them out of their depth. In such a case, the hungry animal continues to flounder in the shallows till knocked on the head, or till the returning tide seasonably comes to its relief. But all this tribe, and the dolphin in particular, are not less swift than destructive. No fish could escape them but from the awkward position of the mouth, which is placed in a manner under the head: yet, even with these disadvantages, their depredations are so great that they have been justly styled the plunderers of the deep.

What could induce the ancients to a predilection in favour of these animals, particularly the dolphin, it is not easy to account for. Historians and philosophers seem to have contended who should invent the greatest number of fables concerning them. The dolphin was celebrated in the earliest times for its fondness to the human race, and was distinguished by the epithets of the *boy-loving* and *philanthropist*. Scarcely an accident could happen at sea but the dolphin offered himself to convey the unfortunate to shore. The musician flung into the sea by pirates, the boy taking an airing into the midst of the sea, and returning again in safety, were obliged to the dolphin for its services. It is not easy, I say, to assign a cause why the ancients should thus have invented so many fables in their favour. The figure of these animals is far from prejudicing us in their interests; their extreme rapacity tends still less to endear them: I know nothing that can reconcile them to man, and excite his prejudices, except that when taken they sometimes have a plaintive moan, with which they continue to express their pain till they expire. This, at first, might have excited human pity, and that might have produced affection. At

present, these fishes are regarded even by the vulgar in a very different light: their appearance is far from being esteemed a favourable omen by the seamen; and from their boundings, springs, and frolics in the water, experience has taught the mariners to prepare for a storm.

But it is not to one circumstance only that the ancients have confined their fabulous reports concerning these animals; as from their leaps out of their element they assume a temporary curvature, which is by no means their natural figure in the water, the old painters and sculptors have universally drawn them wrong. A dolphin is scarcely ever exhibited by the ancients in a straight shape, but curved, in the position which they sometimes appear in when exerting their force; and the poets too have adopted the general error. Even Pliny, the best naturalist, has asserted, that they instantly die when taken out of the water; but Rondelet, on the contrary, assures us, that he has seen a dolphin carried alive from Montpelier to Lyons.

The moderns have more just notions of these animals, and have got over the many fables, which every day's experience contradicts. Indeed their numbers are so great, and, though shy, they are so often taken, that such peculiarities, if they were possessed of any, would have been long since ascertained. They are found, the porpoise especially, in such vast numbers, in all parts of the sea that surrounds this kingdom, that they are sometimes noxious to seamen, when they sail in small vessels. In some places they almost darken the water as they rise to take breath, and particularly before bad weather are much agitated, swimming against the wind, and tumbling about with unusual violence.

Whether these motions be the gambols of pleasure, or the agitations of terror, is not well known. It is most probable that they dread those seasons of turbulence, when the lesser fishes shrink to the bottom, and their prey no longer offers in sufficient abundance. In times of fairer weather, they are seen herding together, and pursuing shoals of various fish with great impetuosity. Their method of hunting their game, if it may be so called, is to follow in a pack, and thus give each other mutual assistance. At that season when the mackerel, the herring, the salmon, and other fish of passage, begin to make their appearance, the cetaceous tribes are seen fierce in the pursuit; urging their prey from one creek or bay to another, deterring them from the shallows, driving them towards each other's ambush, and using a greater variety of arts than hounds are seen to exert in pursuing the hare. However, the porpoise not only seeks for prey near the surface, but often descends to the bottom in search of sand-eels and sea-worms, which it roots out of the sand with its nose, in the manner hogs harrow up the fields for food. For this purpose, the nose projects a little, is shorter and stronger than that of the dolphin; and the neck is furnished with very strong muscles, which enable it the readier to turn up the sand.

But it sometimes happens, that the impetuosity, or the hunger, of these animals, in their usual pursuits, urges them beyond the limits of safety. The fishermen who extend their long nets for pilchards on the coast of Cornwall, have sometimes an unwelcome capture in one of these. Their feeble nets, which are calculated only for taking smaller prey, suffer an universal laceration from the efforts of this strong animal to escape; and if it be not knocked on the head, before it has had time to flounder, the nets are destroyed, and the fishery interrupted. There is nothing, therefore, they so much dread as the entangling a porpoise; and they do every thing to intimidate the animal from approaching.

Indeed, these creatures are so violent in the pursuit of their prey, that they sometimes follow a shoal of small fishes up a fresh-water river, from whence they find no small difficulty to return. We have often seen them taken in the Thames at London, both above the bridges and below them. It is curious enough to observe with what activity they avoid their pursuers, and what little time they require to fetch breath above the water. The manner of killing them is for four or five boats to spread over the part of the river in which they are seen, and with fire-arms to shoot at them the instant they rise above the water. The fish being thus for some time kept in agitation, requires to come to the surface at quicker intervals, and thus affords the marksmen more frequent opportunities.

When the porpoise is taken, it becomes no inconsiderable capture, as it yields a very large quantity of oil; and the lean of some, particularly if the animal be young, is said to be as well tasted as veal. The inhabitants of Norway prepare, from the eggs found in the body of this fish, a kind of caviar, which is said to be very delicate sauce, or good when even eaten with bread. There is a fishery for porpoise along the Western Isles of Scotland during the summer season, when they abound on that shore; and this branch of industry turns to good advantage.

As for the rest, we are told, that these animals go with young ten months; that, like the whale, they seldom bring forth above one at a time, and that in the midst of summer; that they live to a considerable age, though some say not above twenty-five or thirty years; and they sleep with the snout above water. They seem to possess, in a degree proportioned to their bulk, the manners of whales; and the history of one species of cetaceous animals will, in a great measure, serve for all the rest.

PART II.

OF CARTILAGINOUS FISHES.

CHAPTER I.

OF CARTILAGINOUS FISHES IN GENERAL.

We have seen that fishes of the cetaceous kind bear a strong resemblance to quadrupeds in their conformation; those of the cartilaginous kinds are one remove separated from them; they form the shade that completes the imperceptible gradations of nature.

The first great distinction they exhibit is, in having cartilages or gristles instead of bones. The cetaceous tribes have their bones entirely resembling those of quadrupeds, thick, white, and filled with marrow: those of the spinous kind, on the contrary, have small slender bones, with points resembling thorns, and generally solid throughout. Fishes of the cartilaginous kinds have their bones always soft and yielding; and age, that hardens the bones of other animals, rather contributes still more to soften theirs. The size of all fishes increases with age; but from the pliancy of the bones in this tribe, they seem to have no bound placed to their dimensions; and it is supposed that they grow larger every day till they die.

They have other differences more obviously discernible. We have observed, that the cetaceous tribes had lungs like quadrupeds, a heart with its partition in the same manner, and an apparatus for hearing. On the other hand we mentioned, that the spinous kinds had no organs of hearing, no lungs to breathe through, and no partition in the heart; but that their cold red blood was circulated by the means of the impulse made upon their gills by the water. Cartilaginous fishes unite both these systems in their conformation: like the cetaceous tribes they have organs of hearing, and lungs; like the spinous kinds they have gills, and a heart without a partition. Thus possessed of a twofold power of breathing, sometimes by means of their lungs, sometimes by that of their gills, they seem to unite all the advantages of which their situation is capable, and drawing from both elements every aid to their necessities or their enjoyments.

This double capacity of breathing in these animals, is one of the most remarkable features in the history of nature. The apertures by which they breathe are somewhere placed about the head; either beneath, as in flat fish; on the sides, as in sharks; or on the top of the head, as in pipe-fish. To these apertures are the gills affixed, but without any bone to open and shut them as in spinous fishes; from which, by this mark, they may be easily

distinguished, though otherwise very much alike in appearance. From these are bending cylindrical ducts, that run to the lungs, and are supposed to convey the air that gives the organs their proper play. The heart, however, has but one valve; so that their blood wants that double circulation which obtains in the cetaceous kinds; and the lungs seem to me rather as an internal assistant to the gills, than fitted for supplying the same offices as in quadrupeds, for they want the pulmonary vein and artery.

From this structure, however, the animal is enable to live a longer time out of water than those whose gills are more simple. The cartilaginous shark, or ray, lives some hours after it is taken; while the spinous herring or mackerel expire a few minutes after they are brought on shore. From hence this tribe seems possessed of powers that other fishes are wholly deprived of; they can remain continually under water without ever taking breath, while they can venture their heads above the deep, and continue for hours out of their native element.

We observed in a former chapter, that spinous fishes have not, or at least appear not to have, externally, any instruments of generation. It is very different with those of the cartilaginous kind, for the male always has these instruments double. The fish of this tribe are not unfrequently seen to copulate; and their manner is belly to belly, such as may naturally be expected from animals whose parts of generation are placed forward. They in general choose colder seasons and situations than other fish for propagating their kind, and many of them bring forth in the midst of winter.

The same duplicity of character which marks their general conformation, obtains also with regard to their manner of bringing forth. Some bring forth their young alive; and some bring forth eggs, which are afterwards brought to maturity. In all, however, the manner of gestation is nearly the same; for upon dissection it is ever found, that the young, while in the body, continue in the egg till a very little time before they are excluded: these eggs they may properly be said to hatch within their body; and as soon as their young quit the shell, they begin to quit the womb also. Unlike to quadrupeds, or the cetaceous tribes, that quit the egg state a few days after their first conception, and continue in the womb several months after, these continue in the body of the female in their egg state for weeks together; and the eggs are found linked together by a membrane, from which, when the fœtus gets free, it continues but a very short time till it delivers itself from its confinement in the womb. The eggs themselves consist of a white and a yolk, and have a substance, instead of shell, that aptly may be compared to softened horn. These, as I observed, are sometimes hatched in the womb, as in the shark and ray kinds; and they are sometimes excluded, as in the sturgeon, before the animal comes to its time of disengaging. Thus we see that there seems very little difference between the viviporous

and the oviparous kinds, in this class of fishes; the one hatch their eggs in the womb, and the young continue no long time there; the others exclude their eggs before hatching, and leave it to time and accident to bring their young to maturity.

Such are the peculiar marks of the cartilaginous class of fishes, of which there are many kinds. To give a distinct description of every fish is as little my intention, as perhaps it is the wish of the reader: but the peculiarities of each kind deserve notice, and the most striking of these it would be unpardonable to omit.

Cartilaginous fish may be divided first into those of the shark kind with a body growing less towards the tail, a rough skin, with the mouth placed far beneath the end of the nose, five apertures on the sides of the neck for breathing, and the upper part of the tail longer than the lower. This class chiefly comprehends the Great White Shark, the Balance Fish, the Hound Fish, the Monk Fish, the Dog Fish, the Basking Shark, the Zygæna, the Tope, the Cat Fish, the Blue Shark, the Sea Fox, the Smooth Hound Fish, and the Porbeagle. These are all of the same nature, and differ more in size than in figure or conformation.

The next division is that of the flat fish; and these, their broad, flat, thin shape, is sufficiently capable of distinguishing from all others of this kind. They may be easily distinguished also from spinous flat fish, by the holes through which they breathe, which are uncovered by a bone, and which, in this kind, are five on each side. In this tribe we may place the Torpedo, the Skate, the Sharp-nosed Ray, the Rough Ray, the Thornback, and the Fire-Flare.

The third division is that of the slender snake-shaped kind: such as the Lamprey, the Pride, and the Pipe Fish.

The fourth division is of the Sturgeon and its variety, the Isinglass Fish.

The last division may comprise fish of different figures and natures, that do not rank under the former divisions. These are the Sun Fish, the Tetrodon, the Lump Fish, the Sea Snail, the Chimera, and the Fishing Frog. Each of these has somewhat peculiar in its powers or its form, that deserves to be remarked. The description of the figures of these at least may compensate for our general ignorance of the rest of their history.

CHAPTER II.

OF CARTILAGINOUS FISHES OF THE SHARK KIND.

Of all the inhabitants of the deep, those of the shark kind are the fiercest and the most voracious. The smallest of this tribe is not less dreaded by greater fish, than many that to appearance seem more powerful; nor do any of them seem fearful of attacking

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animals far above their size. But the Great White Shark, which is the largest of the kind, joins to the most amazing rapidity the strongest appetites for mischief: as he approaches nearly in size to the whale, he far surpasses him in strength and celerity, in the formidable arrangement of his teeth, and his insatiable desire of plunder.

The white shark is sometimes seen to rank even among whales for magnitude; and is found from twenty to thirty feet long. Some assert that they have seen them of four thousand pound weight; and we are told particularly of one, that had a human corpse in its belly. The head is large, and somewhat flatted; the snout long, and the eyes large. The mouth is enormously wide, as is the throat, and capable of swallowing a man with great ease. But its furniture of teeth is still more terrible: of these there are six rows, extremely hard, sharp-pointed, and of a wedge-like figure. It is asserted that there are seventy-two in each jaw, which make one hundred and forty-four in the whole; yet others think that their number is uncertain, and that, in proportion as the animal grows older, these terrible instruments of destruction are are found to increase. With these the jaws both above and below appear planted all over; but the animal has a power of erecting or depressing them at pleasure. When the shark is at rest, they lie quite flat in his mouth; but when he prepares to seize his prey, he erects all this dreadful apparatus, by the help of a set of muscles that join them to the jaw; and the animal he seizes dies pierced with a hundred wounds in a moment.

Nor is this fish less terrible to behold as to the rest of his form: his fins are larger in proportion; he is furnished with great goggle eyes, that he turns with ease on every side, so as to see his prey behind him as well as before; and his whole aspect is marked with a character of malignity: his skin also is rough, hard, and prickly, being that substance which covers instrument-cases, called shagreen.

As the shark is thus formidable in his appearance, so is he also dreadful from his courage and activity. No fish can swim so fast as he; none so constantly employed in swimming; he outstrips the swiftest ships, plays round them, darts out before them, returns, seems to gaze at the passesngers, and all the while does not seem to exhibit the smallest symptoms of an effort to proceed. Such amazing powers, with such great appetites for destruction, would quickly unpeople even the ocean, but providentially the shark's upper jaw projects so far above the lower, that he is obliged to turn on one side (not on his back, as is generally supposed) to seize his prey. As this takes some small time to perform, the animal pursued seizes that opportunity to make its escape.

Still, however, the depredations he commits are frequent and formidable. The shark is the dread of sailors in all hot climates, where, like a greedy robber, he attends the ships, in expectation of what may drop over-board. A man who unfortunately falls

into the sea at such a time, is sure to perish without mercy. A sailor that was bathing in the Mediterranean, near Antibes, in the year 1744, while he was swimming about fifty yards from the ship, perceived a monstrous fish making towards him and surveying him on every side, as fish are often seen to look round a bait. The poor man, struck with terror at its approach, cried out to his companions in the vessel to take him on board. They accordingly threw him a rope with the utmost expedition, and were drawing him up the ship's side, when the shark darted after him from the deep, and snapped off his leg.

Mr. Pennant tells us, that the master of a Guinea ship, finding a rage for suicide prevail among his slaves, from a notion the unhappy creatures had, that after death they should be restored again to their families, friends, and country; to convince them at least that some disgrace should attend them here, he ordered one of their dead bodies to be tied by the heels to a rope, and so let down into the sea; and though it was drawn up again with great swiftness, yet, in that short space, the sharks had bit off all but the feet. Whether this story is prior to an accident of the same kind, which happened at Belfast, in Ireland, about twenty years ago, I will not take upon me to determine; but certain it is, there are some circumstances alike in both, though more terrible in that I am going to relate. A Guinea captain was by stress of weather driven into the harbour of Belfast, with a lading of very sickly slaves, who, in the manner above mentioned, took every opportunity to throw themselves over-board when brought up upon the deck, as is usual, for the benefit of the fresh air. The captain perceiving, among others, a woman slave attempting to drown herself, pitched upon her as a proper example to the rest: as he supposed that they did not know the terrors attending death, he ordered the woman to be tied with a rope under the arm-pits, and so let down into the water. When the poor creature was thus plunged in, and about half way down, she was heard to give a terrible shriek, which at first was ascribed to her fears of drowning; but soon after, the water appearing red all round her, she was drawn up, and it was found that a shark, which had followed the ship, had bit her off from the middle.

Such is the frightful rapacity of this animal, nothing that has life is rejected. But it seems to have a peculiar enmity to man: when once it has tasted human flesh, it never desists from haunting those places where it expects a return of its prey.

It is even asserted, that along the coasts of Africa, where these animals are found in great abundance, numbers of the Negroes, who are obliged to frequent the waters, are seized and devoured by them every year. The people of these coasts are firmly of opinion, that the shark loves the black man's flesh in preference to the white; and that when men of different colours are in the water together, it always makes choice of the former.

However this be, men of all colours are equally afraid of this

animal, and have contrived different methods to destroy him. In general, they derive their success from the shark's own rapacity. The usual method of our sailors to take him is by baiting a great hook with a piece of beef or pork, which is thrown out into the sea by a strong cord, strengthened near the hook with an iron chain. Without this precaution, the shark would quickly bite the cord in two, and thus set himself free. It is no unpleasant amusement to observe this voracious animal coming up to survey the bait, particularly when not pressed by hunger. He approaches it, examines it, swims round it, seems for a while to neglect it, perhaps apprehensive of the cord and the chain: he quits it for a little; but his appetite pressing, he returns again, appears preparing to devour it, but quits it once more. When the sailors have sufficiently diverted themselves with his different evolutions, they then make a pretence, by drawing the rope, as if intending to take the bait away: it is then that the glutton's hunger excites him; he darts at the bait and swallows it, hook and all. Sometimes, however, he does not so entirely gorge the whole, but that he once more gets free; yet even then, though wounded and bleeding with the hook, he will again pursue the bait until he is taken. When he finds the hook lodged in his maw, his utmost efforts are then excited, but in vain, to get free; he tries with his teeth to cut the chain; he pulls with all his force to break the line; he almost seems to turn his stomach inside out, to disgorge the hook; in this manner he continues his formidable though fruitless efforts, till, quite spent, he suffers his head to be drawn above water, and the sailors, confining his tail by a noose, in this manner draw him on ship-board, and dispatch him. This is done by beating him on the head till he dies; yet even that is not effected without difficulty and danger: the enormous creature, terrible even in the agonies of death, still struggles with his destroyers; nor is there an animal in the world that is harder to be killed. Even when cut in pieces, the muscles still preserve their motion, and vibrate for some minutes after being separated from the body. Another method of taking him, is by striking a barbed instrument, called a *fizgig*, into his body, as he brushes along by the side of the ship. As soon as he is taken up, to prevent his flouncing, they cut off the tail with an axe, with the utmost expedition.

This is the manner in which Europeans destroy the shark; but some of the Negroes along the African coast take a bolder and more dangerous method to combat their terrible enemy. Armed with nothing more than a knife, the Negro plunges into the water, where he sees the shark watching for his prey, and boldly swims forward to meet him: though the great animal does not come to provoke the combat, he does not avoid it, and suffers the man to approach him; but just as he turns upon his side to seize the aggressor, the Negro watches the opportunity, plunges his knife into the fish's belly, and pursues his blows with such success, that

he lays the ravenous tyrant dead at the bottom: he soon however returns, fixes the fish's head in a noose, and drags him to shore, where he makes a noble feast for the adjacent villages.

Nor is man the only enemy this fish has to fear; the Remora, or Sucking Fish, is probably a still greater, and follows the shark everywhere. This fish has got a power of adhering to whatever it sticks against, in the same manner as a cupping-glass sticks to the human body. It is by such an apparatus that this animal sticks to the shark, and drains away its moisture. The seamen, however, are of opinion, that it is seen to attend on the shark for more friendly purposes, to point him to his prey, and to apprize him of his danger. For this reason it has been called the Shark's Pilot.

The shark so much resembles the whale in size, that some have injudiciously ranked it in the class of cetaceous fishes; but its real rank is in the place here assigned it, among those of the cartilaginous kind. It breathes with gills and lungs, its bones are gristly, and it brings forth several living young: Bellonius assures us, that he saw a female shark produce eleven live young ones at a time. But I will not take upon me to vouch for the veracity of Rondeletius, who, when talking of the blue shark, says, that the female will permit her small brood, when in danger, to swim down her mouth, and take shelter in her belly. Mr. Pennant, indeed, seems to give credit to the story, and thinks that this fish, like the opossum, may have a place fitted by nature for the reception of her young. To his opinion much deference is due, and it is sufficient at least to make us suspend our dissent, for nothing is so contemptible as that affectation of wisdom which some display, by universal incredulity.

Upon the whole, a shark when living is a very formidable animal, and when dead is of very little value. The flesh is hardly digestible by any but the Negroes, who are fond of it to distraction; the liver affords three or four quarts of oil; some imaginary virtues have been ascribed to the brain; and its skin is by great labour polished into that substance called shagreen. Mr. Pennant is of opinion that the female is larger than the male in all this tribe, which would, if confirmed by experience, make a striking agreement between them and birds of prey. It were to be wished that succeeding historians would examine into this observation, which is offered only as a conjecture.

CHAPTER III.

OF CARTILAGINOUS FLAT FISH, OR THE RAY KIND.

THE same rapacity which impels the shark along the surface of the water, actuates the flat fish at the bottom. Less active and less formidable, they creep in security along the bottom, seize every thing that comes in their way; neither the hardest shells nor the sharpest spines give protection to the animals that bear them; their insatiable hunger is such that they devour all, and the force of their stomach is so great that it easily digests them.

The whole of this kind resemble each other very strongly in their figure, nor is it easy without experience to distinguish one from another. The stranger to this dangerous tribe may imagine he is only handling a skate, when he is instantly struck numb by the torpedo; he may suppose he has caught a thornback, till he is stung by the fire-flare. It will be proper, therefore, after describing the general figure of these animals, to mark their differences.

All fish of the ray kind are broad, cartilaginous, swimming flat on the water, and having spines on different parts of their body, or at the tail. They all have their eyes and mouth placed quite under the body, with apertures for breathing either about or near them. They all have teeth,, or a rough bone which answers the same purpose. Their bowels are very wide towards the mouth, and go on diminishing to the tail. The tail is very differently shaped from that of other fishes, and at first sight more resembling that of a quadruped, being narrow, and ending either in a bunch or a point. But what they are chiefly distinguished by is their spines or prickles, which the different species have on different parts of their body. Some are armed with spines both above and below, others have them on the upper part only; some have their spines at the tail; some have three rows of them, and others but one. These prickles in some are comparatively soft and feeble, those of others strong and piercing. The smallest of these spines are usually inclining towards the tail, the larger towards the head.

It is by the spines that these animals are distinguished from each other. The skate has the middle of the back rough, and a single row of spines on the tail. The sharp-nosed ray has ten spines, that are situated towards the middle of the back. The rough ray has its spines spread indiscriminately over the whole back. The thornback has its spines disposed in three rows upon the back. The fire-flare has but one spine, but that indeed a terrible one. This dangerous weapon is placed on the tail, about four inches from the body, and is not less than five inches long. It is of a flinty hardness, the sides thin, sharp-pointed, and closely and sharply bearded the whole way. The last of this tribe that I shall mention is the torpedo, and this animal has no spines that can

wound, but in the place of them, it is possessed of one of the most potent and extraordinary faculties in nature.

Such are the principal differences that may enable us to distinguish animals, some of which are of very great use to mankind, from others that are terrible and noxious. With respect to their uses, indeed, as we shall soon see, they differ much; but the similitude among them as to their nature, appetites, and conformation, is perfect and entire. They are all as voracious as they are plenty, and as dangerous to a stranger as useful to him who can distinguish their differences.

Of all the larger fish of the sea, these are the most numerous; and they owe their numbers to their size. Except the white shark and cachalot alone, there is no other fish that has a swallow large enough to take them in; and their spines make them a still more dangerous morsel. Yet the size of some is such that even the shark himself is unable to devour them: we have seen some of them in England weigh above two hundred pounds; but that is nothing to their enormous bulk in other parts of the world. Labat tells us of a prodigious ray that was speared by the Negroes at Guadaloupe, which was thirteen feet eight inches broad, and above ten feet from the snout to the insertion of the tail. The tail itself was in proportion, for it was not less than fifteen feet long; twenty inches broad at its insertion, and tapering to a point. The body was two feet in depth; the skin as thick as leather, and marked with spots; which spots, in all of this kind, are only glands, that supply a mucus to lubricate and soften the skin. This enormous fish was utterly unfit to be eaten by the Europeans; but the Negroes chose out some of the nicest bits, and carefully salted them up as a most favourite provision.

Yet large as this may seem, it is very probable that we have seen only the smallest of the kind: as they generally keep at the bottom, the largest of the kind are seldom seen; and as they may probably have been growing for ages, the extent of their magnitude is unknown. It is generally supposed, however, that they are the largest inhabitants of the deep; and were we to credit the Norway Bishop, there are some above a mile over. But to suppose an animal of such magnitude is absurd; yet the over-stretching the supposition does not destroy the probability that animals of this tribe grow to an enormous size.

The ray generally chooses for its retreat such parts of the sea as have a black muddy bottom: the large ones keep at greater depths, but the smaller approach the shores, and feed upon whatever living animals they can surprise, or whatever putrid substances they meet with. As they are ravenous, they easily take the bait, yet will not touch it if it be taken up and kept a day or two out of water. Almost all fish appear much more delicate with regard to a baited hook than their ordinary food. They appear by their manner to perceive the line, and to dread it; but the impulse of their hunger is too great for their caution, and even though

they perceive the danger, if thoroughly hungry they devour the destruction.

These fish generate in March and April, at which time only they are seen swimming near the surface of the water, several of the males pursuing one female. They adhere so fast together in coition that the fishermen frequently draw up both together, though only one has been hooked. The females are prolific to an extreme degree, there having been no less than three hundred eggs taken out of the body of a single ray. These eggs are covered with a tough horny substance, which they acquire in the womb; for before they descend into that, they are attached to the ovary pretty much in the same manner as in the body of a pullet. From this ovary, or egg-bag, as it is vulgarly called, the fish's eggs drop one by one into the womb, and there receive a shell by the concretion of the fluids of that organ. When come to the proper maturity, they are excluded, but never above one or two at a time, and often at intervals of three or four hours. These eggs, or purses, as the fishermen call them, are usually cast about the beginning of May, and they continue casting during the whole summer. In October, when their breeding ceases, they are exceedingly poor and thin; but in November they begin to improve, and grow gradually better till May, when they are in the highest perfection.

It is chiefly during the winter season that our fishermen take them; but the Dutch, who are indefatigable, begin their operations earlier, and fish with better success than we. The method practised by the fishermen of Scarborough is thought to be the best among the English; and as Mr. Pennant has given a very succinct account of it, I will take leave to present it to the reader.

"When they go out to fish, each person is provided with three lines; each man's lines are fairly coiled upon a flat oblong piece of wicker work, the hooks being baited and placed very regularly in the centre of the coil. Each line is furnished with two hundred and eighty hooks, at the distance of six feet two inches from each other. The hooks are fastened to lines of twisted horse-hair, twenty-seven inches in length.

"When fishing, there are always three men in each coble; and consequently nine of these lines are fastened together and used as one line, extending in length near three miles, and furnished with above two thousand five hundred hooks. An anchor and a buoy are fixed at the first end of the line, and one more at each end of each man's lines; in all, four anchors and four buoys made of leather or cork. The line is always laid across the current. The tides of flood and ebb continue an equal time upon our coast; and, when undisturbed by winds, run each way about six hours. They are so rapid that the fishermen can only shoot and haul their lines at the turn of the tide; and therefore the lines always remain upon the ground about six hours. The same

rapidity of tide prevents their using hand-lines; and therefore two of the people commonly wrap themselves in the sail, and sleep, while the other keeps a strict look-out, for fear of being run down by ships, and to observe the weather; for storms often rise so suddenly, that it is sometimes with extreme difficulty they escape to the shore, though they leave their lines behind them.

"The coble is twenty feet six inches long, and five feet extreme breadth. It is about one ton burden, rowed with three pair of oars, and admirably constructed for the purpose of encountering a mountainous sea. They hoist sail when the wind suits.

"The five-men-boat is forty feet long, fifteen broad, and twenty-five tons burden. It is so called, though navigated by six men and a boy, because one of the men is hired to cook, and does not share in the profits of the other five. All our able fishermen go in these boats to the herring-fishery at Yarmouth, the latter end of September, and return about the middle of November. The boats are then laid up until the beginning of Lent, at which time they go off in them to the edge of the Dogger, and other places, to fish for turbot, cod, ling, skate, &c. They always take two cobles on board, and when they come upon their ground, anchor the boat, throw out the cobles, and fish in the same manner as those do who go from the shore in a coble; with this difference only, that here each man is provided with double the quantity of lines, and, instead of waiting the return of the tide in the coble, return to the boat and bait their other lines—thus hauling one set, and shooting another, every turn of tide. They commonly run into the harbour twice a week, to deliver their fish. The five-men-boat is decked at each end, but open in the middle, and has two long sails.

"The best bait for all kinds of fish is fresh herring cut in pieces of a proper size; and, notwithstanding what has been said to the contrary, they are taken there at any time in the winter, and all the spring, whenever the fishermen put down their nets for that purpose: the five-men-boats always take some nets for that end. Next to herrings are the lesser lampreys, which come all winter by land-carriage from Tadcaster. The next baits in esteem are small haddocks cut in pieces, sand-worms, muscles, and limpets; and lastly, when none of these can be found, they use bullock's liver. The hooks used there are much smaller than those employed at Iceland and Newfoundland. Experience has shown that the larger fish will take a living small one upon the hook, sooner than any bait that can be put on; therefore they use such as the fish can swallow. The hooks are two inches and a half long in the shank, and near an inch wide between the shank and the point. The line is made of small cording, and is always tanned before it is used. All the rays and turbots are extremely delicate in their choice of baits; if a piece of herring or haddock has been twelve hours out of the sea, and then used as a bait, they will not touch it."

Such is the manner of fishing for those fish that usually keep near the bottom on the coasts of England; and Duhamel observes, that the best weather for succeeding is a half calm, when the waves are just curled with a silent breeze.

But this extent of line, which runs, as we have seen, three miles along the bottom, is nothing to what the Italians throw out in the Mediterranean. Their fishing is carried on in a tartan, which is a vessel much larger than ours; and they bait a line of no less than twenty miles long, with above ten or twelve thousand hooks. This line is called the *parasina*, and the fishing goes by that of the *pielago*. This line is not regularly drawn every six hours, as with us, but remains for some time in the sea; and it requires the space of twenty-four hours to take it up. By this apparatus they take rays, sharks, and other fish; some of which are above a thousand pounds weight. When they have caught any of this magnitude, they strike them through with an harpoon to bring them on board, and kill them as fast as they can.

This method of catching fish is obviously fatiguing and dangerous; but the value of the capture generally repays the pains. The skate and the thornback are very good food; and their size, which is from ten pounds to two hundred weight, very well rewards the trouble of fishing for them. But it sometimes happens that the lines are visited by very unwelcome intruders, by the rough-ray, the fire-flare, or the torpedo. To all these the fishermen have the most mortal antipathy, and when discovered, shudder at the sight; however, they are not always so much upon their guard, but that they sometimes feel the different resentments of this angry tribe, and, instead of a prize, find they have caught a vindictive enemy. When such is the case, they take care to throw them back into the sea with the swiftest expedition.

The rough-ray inflicts but slight wounds with the prickles with which its whole body is furnished. To the ignorant it seems harmless, and a man would at first sight venture to take it in his hand without any apprehension; but he soon finds that there is not a single part of its body that is not armed with spines, and that there is no way of seizing the animal but by the little fin at the end of the tail.

But this animal is harmless when compared to the fire-flare, which seems to be the dread of even the boldest and most experienced fishermen. The weapon with which nature has armed this animal, which grows from the tail, and which we described as barbed, and five inches long, hath been an instrument of terror to the ancient fishermen as well as the modern; and they have delivered many tremendous fables of its astonishing effects. Pliny, Ælian, and Oppian, have supplied it with a venom that affects even the inanimate creation; trees that are struck by it instantly lose their verdure, and rocks themselves are incapable of resisting the potent poison. The enchantress Circe armed her son with a spear headed with the spine of the trygon, as the most irresistible

weapon she could furnish him with; a weapon that soon after was to be the death of his own father.

"That spears and darts," says Mr. Pennant, "might in very early times have been headed with this bone instead of iron, we have no doubt. The Americans head their arrows with the bones of fishes to this day; and from their hardness and sharpness, they are no contemptible weapons. But that this spine is possessed of those venomous qualities ascribed to it, we have every reason to doubt; though some men of high reputation, and the whole body of fishermen, contend for its venomous effects. It is, in fact, a weapon of offence belonging to this animal, and capable, from its barbs, of inflicting a very terrible wound, attended with dangerous symptoms; but it cannot be possessed of any poison, as the spine has no sheath to preserve the supposed venom on its surface, and the animal has no gland that separates the noxious fluid: besides, all those animals that are furnished with envenomed fangs or stings, seem to have them strongly connected with their safety and existence; they never part with them; there is an apparatus of poison prepared in the body to accompany their exertions; and when the fangs or stings are taken away, the animal languishes and dies. But it is otherwise with the spine of the fire-flare: it is fixed to the tail as a quill is into the tail of the fowl, and is annually shed in the same manner; it may be necessary for the creature's defence, but it is no way necessary for its existence. The wound inflicted by an animal's tail has something terrible in the idea, and may from thence alone be supposed to be fatal. From hence terror might have added poison to the pain, and called up imagined dangers: the Negroes universally believe that the sting is poisonous, but they never die of the wound; for, by opening the fish, and laying it to the part injured, it effects a speedy cure. The slightness of the remedy proves the innocence of the wound.

The Torpedo is an animal of this kind, equally formidable and well known with the former; but the manner of its operating is to this hour a mystery to mankind. The body of this fish is almost circular, and thicker than others of the ray kind; the skin is soft, smooth, and of a yellowish colour, marked, as all the kind, with large annular spots; the eyes very small, the tail tapering to a point, and the weight of the fish from a quarter to fifteen pounds. Redi found one twenty-four pounds weight. To all outward appearance it is furnished with no extraordinary powers; it has no muscles formed for particular great exertions, no internal conformation perceptibly differing from the rest of its kind: yet such is that unaccountable power it possesses, that, the instant it is touched, it numbs not only the hand and arm, but sometimes also the whole body. The shock received, by all accounts, most resembles the stroke of an electrical machine—sudden, tingling, and painful. "The instant," says Kempfer, "I touched it with my hand, I felt a terrible numbness in my arm, and as far up as

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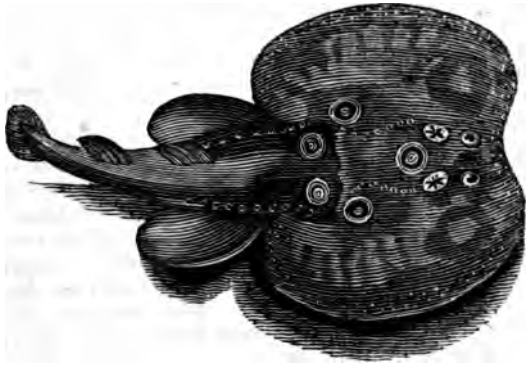


TORPEDO

the shoulder. Even if one treads upon it with the shoe on, it affects not only the leg, but the whole thigh upwards. Those who touch it with the foot, are seized with a stronger palpitation than even those who touch it with the hand. This numbness bears no resemblance to that which we feel when a nerve is a long time pressed, and the foot is said to be asleep; it rather appears like a sudden vapour, which passing through the pores, in an instant penetrates to the very springs of life, from whence it diffuses itself over the whole body, and gives real pain. The nerves are so affected, that the person struck imagines all the bones of his body, and particularly those of the limb that received the blow, are driven out of joint. All this is accompanied with an universal tremor, a sickness of the stomach, a general convulsion, and a total suspension of the faculties of the mind. In short," continues Kempfer, "such is the pain, that all the force of our promises and authority could not prevail upon a seaman to undergo the shock a second time. A Negro, indeed, that was standing by, readily undertook to touch the torpedo, and was seen to handle it without feeling any of its effects. He informed us, that his whole secret consisted in keeping in his breath; and we found upon trial that this method answered with ourselves. When we held in our breath, the torpedo was harmless; but when we breathed ever so little, its efficacy took place."

Kempfer has very well described the effects of this animal's shock; but succeeding experience has abundantly convinced us, that holding in the breath no way guards against its violence. Those, therefore, who, depending on that receipt, should play with a torpedo, would soon find themselves painfully undeceived: not but this fish may be many times touched with perfect security, for it is not upon every occasion that it exerts its potency. Reaumur, who made several trials upon this animal, has at least convinced the world that it is not necessarily, but by an effort, that the torpedo numbs the hands of him that touches it. He tried several times, and could easily tell when the fish intended the stroke, and when it was about to continue harmless. Always before the fish intended the stroke, it flattened the back, raised the head and the tail, and then, by a violent contraction in the opposite direction, struck with its back against the pressing finger, and the body, which before was flat, became humped and round.

But we must not infer, as he has done, that the whole effect of this animal's exertions arise from the greatness of the blow which the fingers receive at the instant they are struck. We will, with him, allow that the stroke is very powerful, equal to that of a musket-ball, since he will have it so; but it is very well known, that a blow, though never so great, on the points of the fingers, diffuses no numbness over the whole body: such a blow might break the ends of the fingers indeed, but would hardly numb the shoulder. Those blows that numb, must be applied immediately to some great and leading nerve, or to a large surface of the body:

a powerful stroke applied to the points of the fingers will be excessively painful indeed, but the numbness will not reach beyond the fingers themselves. We must, therefore, look for another cause producing the powerful effects wrought by the torpedo.

Others have ascribed it to a tremulous motion which this animal is found to possess, somewhat resembling that of a horse's skin, when stung by a fly. This operating under the touch with an amazing quickness of vibration, they suppose produces the uneasy sensation described above—something similar to what we feel when we rub plush cloth against the grain. But the cause is quite disproportioned to the effect, and so much beyond our experience, that this solution is as difficult as the wonder we wish to explain.

The most probable solution seems to be, that the shock proceeds from an animal electricity, which this fish has some hidden power of storing up, and producing on its most urgent occasions. The shocks are entirely similar; the duration of the pain is the same: but how the animal contrives to renew the charge, how it is prevented from evaporating it on contiguous objects, how it is originally procured,—these are difficulties that time alone can elucidate.

But to know even the effects is wisdom. Certain it is, that the powers of this animal seem to decline with its vigour; for as its strength ceases, the force of the shock seems to diminish, till, at last, when the fish is dead, the whole power is destroyed, and it may be handled or eaten with perfect security: on the contrary, when immediately taken out of the sea, its force is very great, and not only affects the hand, but if even touched with a stick, the person finds himself sometimes affected. This power, however, is not to be extended to the degree that some would have us believe; as reaching the fishermen at the end of the line, or numbing fishes in the same pond. Godignus, in his History of Abyssinia, carries this quality to a most ridiculous excess: he tells us of one of these that was put into a basket among a number of dead fishes, and that the next morning the people, to their utter astonishment, perceived, that the torpedo had actually numbed the dead fishes into life again.

To conclude, it is generally supposed that the female torpedo is much more powerful than the male. Lorenzini, who has made several experiments upon this animal, seems convinced that its power wholly resides in two thin muscles that cover a part of the back. These he calls the trembling fibres; and he asserts that the animal may be touched with safety in any other part. It is now known also, that there are more fish than this of the ray kind, possessed of the numbing quality, which has acquired them the name of the torpedo. These are described by Atkins and Moore, and found in great abundance along the coast of Africa. They are shaped like a mackerel, except that the head is much larger: the effects of these seem also to differ in some respects. Moore talks of keeping his hand upon the animal, which, in the ray

torpedo, it is actually impossible to do. "There was no man in the company," says he, "that could bear to keep his hand on this animal the twentieth part of a minute, it gave him so great pain; but upon taking the hand away, the numbness went off, and all was well again. This numbing quality continued in this torpedo even after it was dead; and the very skin was still possessed of its extraordinary powers till it became dry." Condamine informs us of a fish possessed of the powers of the torpedo, of a shape very different from the former, and every way resembling a lamprey. This animal, if touched by the hand, or even with a stick, instantly benumbs the hand and arm to the very shoulder; and sometimes the man falls down under the blow. These animals, therefore, must affect the nervous system in a different manner from the former, both with respect to the manner and the intention; but how this effect is wrought, we must be content to dismiss in obscurity.

CHAPTER VI.

OF THE LAMPREY, AND ITS AFFINITIES.

THERE is a species of the Lamprey served up as great a delicacy among the modern Romans, very different from ours. Whether theirs be the Muræna of the ancients I will not pretend to say; but there is nothing more certain than that our lamprey is not. The Roman lamprey agrees with the ancient fish in being kept in ponds, and considered by the luxurious as a very great delicacy.

The lamprey known among us is differently estimated, according to the season in which it is caught, or the place where it has been fed. Those that leave the sea to deposit their spawn in fresh waters are the best; those that are entirely bred in our rivers, and that have never been at sea, are considered as much inferior to the former. Those that are taken in the months of March, April, or May, just upon their leaving the sea, are reckoned very good; those that are caught after they have cast their spawn, are found to be flabby and of little value. Those caught in several of the rivers of Ireland the people will not venture to touch; those of the English Severn are considered as the most delicate of all other fish whatever.

The lamprey much resembles an eel in its general appearance, but is of a lighter colour, and rather a clumsier make. It differs however in the mouth, which is round, and placed rather obliquely below the end of the nose. It more resembles the mouth of a leech than an eel; and the animal has a hole on the top of the head through which it spouts water, as in the cetaceous kind. There are seven holes on each side for respiration; and the fins are formed rather by a lengthening out of the skin, than any set of bones or

spines for that purpose. As the mouth is formed resembling that of a leech, so it has a property resembling that animal, of sticking close to and sucking any body it is applied to. It is extraordinary the power they have of adhering to stones, which they do so firmly as not to be drawn off without some difficulty. We are told of one that weighed but three pounds, and yet it stuck so firmly to a stone of twelve pounds that it remained suspended at its mouth, from which it was separated with no small difficulty. This amazing power of suction is supposed to arise from the animal's exhausting the air within its body by the hole over the nose, while the mouth is closely fixed to the object, and permits no air to enter. It would be easy to determine the weight this animal is thus able to sustain, which will be equal to the weight of a column of air of equal diameter with the fish's mouth.

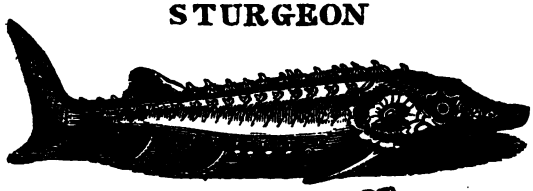
From some peculiarity of formation, this animal swims generally with its body as near as possible to the surface; and it might easily be drowned by being kept by force for any time under water. Muralto has given us the anatomy of this animal; but, in a very minute description, makes no mention of lungs. Yet I am very apt to suspect, that two red glands tissued with nerves, which he describes as lying towards the back of the head, are no other than the lungs of this animal. The absolute necessity it is under of breathing in the air, convinces me that it must have lungs, though I do not know of any anatomist that has described them.

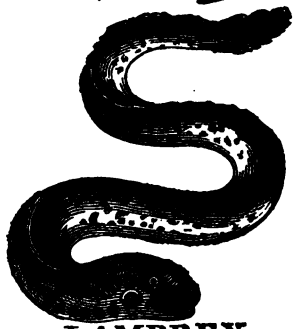
The adhesive quality in the lamprey may be in some measure increased by that slimy substance with which its body is all over smeared; a substance that serves at once to keep it warm in its cold element, and also to keep its skin soft and pliant. This mucus is separated by two long lymphatic canals, that extend on each side from the head to the tail, and that furnish it in great abundance. As to its intestines, it seems to have but one great bowel, running from the mouth to the vent, narrow at both ends, and wide in the middle.

So simple a conformation seems to imply an equal simplicity of appetite. In fact, the lamprey's food is either slime and water, or such small water insects as are scarcely perceivable. Perhaps its appetite may be more active at sea, of which it is properly a native; but when it comes up into our rivers, it is hardly perceived to devour any thing.

Its usual time of leaving the sea, which it is annually seen to do in order to spawn, is about the beginning of spring; and after a stay of a few months it returns again to the sea. Their preparation for spawning is peculiar: their manner is to make holes in the gravelly bottom of rivers; and on this occasion their sucking power is particularly serviceable, for if they meet with a stone of a considerable size, they will remove it and throw it out. Their young are produced from eggs in the manner of flat fish; the female remains near the place where they are excluded, and continues with them till they come forth. She is sometimes seen with her

STURGEON





LAMPREY

SEA DEVIL

whole family playing about her; and after some time she conducts them in triumph back to the ocean.

But some have not sufficient strength to return, and these continue in the fresh water till they die. Indeed, the life of this fish, according to Rondeletius, who has given its history, is but of very short continuance, and a single brood is the extent of the female's fertility. As soon as she has returned after casting her eggs, she seems exhausted and flabby. She becomes old before her time, and two years are generally the limit of her existence.

However this may be, they are very indifferent eating after they have cast their eggs, and particularly at the approach of hot weather. The best season for them is the months of March, April, and May; and they are usually taken in nets with salmon, and sometimes in baskets at the bottom of the river. It has been an old custom for the city of Gloucester annually to present the king with a lamprey-pye; and as the gift is made at Christmas, it is not without great difficulty the corporation can procure the proper quantity, though they give a guinea a-piece for taking them.

How much they were valued among the ancients, or a fish bearing some resemblance to them, appears from all the classics, that have praised good living, or ridiculed gluttony. One story we are told of this fish, with which I will conclude its history. A senator of Rome, whose name does not deserve being transmitted to posterity, was famous for the delicacy of his lampreys. Tigelinus, Manucius, and all the celebrated epicures of Rome, were loud in his praises: no man's fish had such a flavour, were so nicely fed, or so exactly pickled. Augustus, hearing so much of this man's entertainments, desired to be his guest; and soon found that fame had been just to his merits—the man had indeed very fine lampreys, and of an exquisite flavour. The emperor was desirous of knowing the method by which he fed his fish to so fine a relish; and the glutton, making no secret of his art, informed him, that his way was to throw into his ponds such of his slaves as had at any time displeased him. Augustus, we are told, was not much pleased with his receipt, and instantly ordered all his ponds to be filled up. The story would have ended better, if he had ordered the owner to be flung in also.

CHAPTER V.

THE STURGEON, AND ITS VARIETIES.

The Sturgeon, with a form as terrible and a body as large as the shark, is yet as harmless as the fish we have been just describing; incapable and unwilling to injure others, it flies from the smallest fishes, and generally falls a victim to its own timidity.

The sturgeon in its general form resembles a fresh-water pike. The nose is long, the mouth is situated beneath, being small, and without jaw-bones or teeth. But though it is so harmless and ill provided for war, the body is formidable enough to appearance. It is long, pentagonal, and covered with five rows of large bony knobs, one row on the back, and two on each side, and a number of fins to give it greater expedition. Of this fish there are three kinds; the Common Sturgeon, the Caviar Sturgeon, and the Huso or Isinglass Fish. The first has eleven knobs or scales on the back, the second has fifteen, and the latter thirteen on the back, and forty-three on the tail. These differences seem slight to us who only consider the animal's form, but those who consider its uses find the distinction of considerable importance. The first is the sturgeon, the flesh of which is sent pickled into all parts of Europe; the second is the fish from the row of which that noted delicacy called *caviar* is made; and the third, besides supplying the caviar, furnishes also the valuable commodity of isinglass *. They all grow to a very great size, and some of them have been found above eighteen feet long.

There is not a country in Europe but what this fish visits at different seasons; it annually ascends the largest rivers to spawn, and propagates in an amazing degree. The inhabitants along the banks of the Po, the Danube, and the Wolga, make great profit yearly of its incursions up the stream, and have their nets prepared for its reception. The sturgeon also is brought daily to the markets of Rome and Venice, and they are known to abound in the Mediterranean Sea. Yet those fish that keep entirely either in salt or fresh water are but comparatively small. When the sturgeon enjoys the vicissitude of fresh and salt water, it is then that it grows to an enormous size, so as almost to rival even the whale in magnitude.

Nor are we without frequent visits from this much esteemed fish in England. It is often accidentally taken in our rivers in salmon nets, and particularly in those parts that are not far remote from the sea. The largest we have heard of caught in Great Britain was a fish taken in the Esk, where they are most frequently found, which weighed four hundred and sixty pounds. An enormous size to those who have only seen our fresh water fishes!

North America also furnishes the sturgeon; their rivers, in May, June, and July, supply them in very great abundance. At that time they are seen sporting in the water, and leaping from its surface several yards into the air. When they fall again on their

[* Willoughby and others inform us, that isinglass is also made of the sound of the Beluga; and Neumann, that it is made of the Huso Germanorum, and other fish, which are frequently sold in the public markets of Vienna. The sounds of cod, properly prepared, afford this substance; and the lakes of America abound with fish from which the very finest sort may be obtained.—URE's *Dictionary of Chemistry*,—ISINGLASS.]

side, the concussion is so violent that the noise is heard, in still weather, at some miles distance.

But of all places where this animal is to be found, it appears no where in such numbers as in the lakes of Frischehaff and Curischaff, near the city of Pillau. In the rivers also that empty themselves into the Euxine Sea this fish is caught in great numbers, particularly at the mouth of the river Don. In all these places the fishermen regularly expect their arrival from the sea, and have their nets and salt ready prepared for their reception.

As the sturgeon is a harmless fish, and no way voracious, it is never caught by a bait in the ordinary manner of fishing, but always in nets. From the description given above of its mouth, it is not to be supposed that the sturgeon would swallow any hook capable of holding so large a bulk, and so strong a swimmer. In fact, it never attempts to seize any of the finny tribe, but lives by rooting at the bottom of the sea, where it makes insects and sea plants its whole subsistence. From this quality of floundering at the bottom it has received its name, which comes from the German verb *stoeren*, signifying to wallow in the mud. That it lives upon no large animals is obvious to all those who cut it open, where nothing is found in its stomach but a kind of slimy substance, which has induced some to think it lives only upon water and air. From hence there is a German proverb, which is applied to a man extremely temperate, when they say, he is as moderate as a sturgeon.

As the sturgeon is so temperate in its appetites, so is it also equally timid in its nature. There would be scarcely any method of taking it, did not its natural desire of propagation induce it to incur so great a variety of dangers. The smallest fish is alone sufficient to terrify a shoal of sturgeons; for, being unfurnished with any weapon of defence, they are obliged to trust to their swiftness and their caution for security. Like all animals that do not make war upon others, sturgeons live in society among themselves; rather for the purposes of pleasure, than from any power of mutual protection. Gesner even asserts, that they are delighted with sounds of various kinds, and that he has seen them shoal together at the notes of a trumpet.

The usual time, as was said before, for the sturgeon to come up rivers to deposit its spawn, is about the beginning of summer, when the fishermen of all great rivers make a regular preparation for its reception. At Pillau, particularly, the shores are formed into districts, and allotted to companies of fishermen, some of which are rented for about three hundred pounds a-year. The nets in which the sturgeon is caught, are made of small cord, and placed across the mouth of the river; but in such a manner that, whether the tide ebbs or flows, the pouch of the net goes with the stream. The sturgeon thus caught while in the water, is one of the strongest fishes that swims, and often breaks the net to pieces that encloses it; but the instant it is raised with its head above

water, all its activity ceases; it is then a lifeless, spiritless lump, and suffers itself to be tamely dragged on shore. It has been found prudent, however, to draw it to shore gently; for, if excited by any unnecessary violence, it has been found to break the fishermen's legs with a blow of its tail. The most experienced fishers, therefore, when they have drawn it to the brink, keep the head still elevated, which prevents its doing any mischief with the hinder part of the body; others, by a noose, fasten the head and the tail together; and thus, without immediately dispatching it, bring it to the market, if there be one near, or keep it till their number is completed for exportation.

The flesh of this animal pickled, is very well known at all the tables of Europe, and is even more prized in England than in any of the countries where it is usually caught. The fishermen have two different methods of preparing it. The one is by cutting it in long pieces lengthwise, and having salted them, by hanging them up in the sun to dry: the fish thus prepared is sold in all the countries of the Levant, and supplies the want of better provision. The other method, which is usually practised in Holland, and along the shores of the Baltic, is to cut the sturgeon crosswise into short pieces, and put it into small barrels, with a pickle made of salt and saumure. This is the sturgeon which is sold in England, and of which great quantities came from the North, until we gave encouragement to the importation of it from North America. From thence we are very well supplied; but it is said, not with such good fish as those imported from the north of Europe.

A very great trade is also carried on with the roe of the sturgeon, preserved in a particular manner, and called Caviar: it is made from the roe of all kinds of sturgeon, but particularly the second. This is much more in request in other countries of Europe than with us. To all these high relished meats, the appetite must be formed by degrees; and though formerly even in England it was very much in request at the politest tables, it is at present sunk entirely into disuse. It is still, however, a considerable merchandize among the Turks, Greeks, and Venetians. Caviar somewhat resembles soft soap in consistence, but it is of a brown, uniform colour, and is eaten as cheese with bread. The manner of making it is this: They take the spawn from the body of the sturgeon—for it is to be observed that the sturgeon differs from other cartilaginous fish, in that he has spawn like a cod, and not eggs like a ray; they take the spawn, I say, and freeing it from the small membranes that connect it together, they wash it with vinegar, and afterward spread it to dry upon a table; they then put it into a vessel with salt, breaking the spawn with their hands, and not with a pestle; this done, they put it into a canvass bag, letting the liquor drain from it; lastly, they put it into a tub, with holes in the bottom, so that, if there be any moisture

still remaining, it may run out; then it is pressed down, and covered up close for use.

But the Huso or Isinglass fish furnishes a still more valuable commodity. This fish is caught in great quantities in the Danube, from the month of October to January: it is seldom under fifty pounds weight, and often above four hundred: its flesh is soft, glutinous, and flabby; but it is sometimes salted, which makes it better tasted, and then it turns red like salmon. It is for the commodity it furnishes that it is chiefly taken. Isinglass is of a whitish substance, inclining to yellow, done up into rolls, and so exported for use. It is very well known as serviceable not only in medicine, but many arts. The varnisher, the wine-merchant, and even the clothier, knows its uses; and very great sums are yearly expended upon this single article of commerce. The manner of making it is this: They take the skin, the entrails, the fins, and the tail of this fish, and cut them into small pieces; these are left to macerate in a sufficient quantity of warm water, and they are all boiled shortly after with a slow fire, until they are dissolved and reduced to a jelly; this jelly is spread upon instruments made for the purpose, so that, drying, it assumes the form of parchment, and, when quite dry, it is then rolled into the form in which we see it in the shops.

This valuable commodity is principally furnished from Russia, where they prepare great quantities surprisingly cheap. Mr. Jackson, an ingenious countryman of our own, found out an obvious method of making a glue at home, that answered all the purposes of isinglass; but what with the trouble of making it, and perhaps the arts put in practice to undersell him, he was, as I am told, obliged to discontinue the improvement of his discovery. Indeed, it is a vain attempt to manufacture among ourselves those things which may be more naturally and cheaply supplied elsewhere. We have many trades that are unnaturally, if I may so express it, employed among us, who furnish more laboriously those necessaries with which other countries could easily and cheaply supply us. It would be wiser to take what they can thus produce, and to turn our artisans to the increase and manufacture of such productions as thrive more readily among us. Were, for instance, the number of hands that we have now employed in the manufacture of silk, turned to the increase of agriculture, it is probable that the increased quantity of corn thus produced, would be more than an equivalent for the diminution of national wealth in purchasing wrought silk from other countries.

CHAPTER VI.

OF ANOMALOUS CARTILAGINOUS FISHES.

Of all others, the cartilaginous class seems to abound with the greatest variety of ill-formed animals; and, if philosophy could allow the expression, we might say, that the cartilaginous class was the class of monsters: in fact, it exhibits a variety of shapeless beings, the deviations of which from the usual form of fishes, are beyond the power of words to describe, and scarcely of the pencil to draw. In this class we have the Pipe Fish, that almost tapers to a thread, and the Sun Fish, that has the appearance of a bulky head, but the body cut off in the middle; the Hippocampus, with a head somewhat like that of a horse; and the Water Bat, whose head can scarcely be distinguished from the body. In this class we find the Fishing Frog, which from its deformity some have called the Sea Devil, the Chimæra, the Lump Fish, the Sea Porcupine, and the Sea Snail. Of all these the history is but little known, and naturalists supply the place with description.

The Sun Fish sometimes grows to a very large size; one taken near Plymouth was five hundred weight. In form it resembles a bream, or some deep fish cut off in the middle; the mouth is very small, and contains in each jaw two broad teeth, with sharp edges; the colour of the back is dusky and dappled, and the belly is of a silvery white. When boiled it has been observed to turn to a glutinous jelly, and would most probably serve for all the purposes of isinglass, were it found in sufficient plenty.

The Fishing Frog in shape very much resembles a tadpole or young frog, but then a tadpole of enormous size, for it grows to above five feet long, and its mouth is sometimes a yard wide. Nothing can exceed its deformity. The head is much bigger than the whole body; the under jaw projects beyond the upper, and both are armed with rows of slender sharp teeth; the palate and the tongue are furnished with teeth in like manner; the eyes are placed on the top of the head, and are encompassed with prickles; immediately above the nose are two long beards or filaments, small in the beginning, but thicker at the end, and round: these, as it is said, answer a very singular purpose; for being made somewhat resembling a fishing-line, it is asserted, that the animal converts them to the purposes of fishing. With these extended, as Pliny asserts, the fishing-frog hides in muddy waters, and leaves nothing but the beards to be seen: the curiosity of the smaller fish brings them to view these filaments, and their hunger induces them to seize the bait, upon which the animal in ambush instantly draws in its filaments with the little fish that had taken the bait, and devours it without mercy. This story, though apparently improbable, has found credit among some of our best naturalists; but what induces me to doubt the fact is, that there

is another species of this animal that has no beards, which it would not want if they were necessary to the existence of the kind. Rondeletius informs us, that if we take out the bowels, the body will appear with a kind of transparence; and that if a lighted candle be placed within the body, as in a lanthorn, the whole has a very formidable appearance.—The fishermen, however, have in general a great regard for this ugly fish, as it is an enemy to the dog fish, the bodies of those fierce and voracious animals being often found in its stomach: whenever they take it, therefore, they always set it at liberty.

The Lump Fish is trifling in size, compared to the former: its length is but sixteen inches, and its weight about four pounds; the shape of the body is like that of a bream, deep, and swims edgeways; the back is sharp and elevated, and the belly flat; the lips, mouth, and tongue of this animal are of a deep red; the whole skin is rough, with bony knobs, the largest row is along the ridge of the back; the belly is of a bright crimson colour: but what makes the chief singularity in this fish is an oval aperture in the belly, surrounded with a fleshy soft substance, that seems bearded all round; by means of this part it adheres with vast force to any thing it pleases. If flung into a pail of water, it will stick so close to the bottom, that on taking the fish by the tail, one may lift up pail and all, though it holds several gallons of water. Great numbers of these fish are found along the coasts of Greenland in the beginning of summer, where they resort to spawn. Their roe is remarkably large, and the Greenlanders boil it to a pulp for eating. They are extremely fat, but not admired in England, being both flabby and insipid.

The Sea Snail takes its name from the soft and unctuous texture of its body, resembling the snail upon land. It is almost transparent, and soon dissolves and melts away. It is but a little animal, being not above five inches long. The colour, when fresh taken, is of a pale brown, the shape of the body round, and the back-fin reaches all the way from the head to the tail. Beneath the throat is a round depression of a whitish colour, surrounded by twelve brown spots, placed in a circle. It is taken in England, at the mouths of rivers, four or five miles distant from the sea.

The body of the Pipe Fish, in the thickest part, is not thicker than a swan quill, while it is above sixteen inches long. This is angular, but the angles being not very sharp, they are not discernible until the fish is dried. Its general colour is an olive brown, marked with numbers of bluish lines, pointing from the back to the belly. It is viviparous; for, on crushing one that was just taken, hundreds of very minute young ones were observed to crawl about.

The Hippocampus, which from the form of its head some call the Sea Horse, never exceeds nine inches in length. It is about as thick as a man's thumb, and the body is said, while alive, to have hair on the fore part, which falls off when it is dead. The

shout is a sort of tube with a hole at the bottom, to which there is a cover, which the animal can open and shut at pleasure. Behind the eyes there are two fins which look like ears; and above them are two holes, which serve for respiration. The whole body seems to be composed of cartilaginous rings, on the intermediate membranes of which several small prickles are placed. It is found in the Mediterranean, and also in the Western Ocean; and, upon the whole, more resembles a great caterpillar than a fish. The ancients considered it as extremely venomous; probably induced by its peculiar figure.

From these harmless animals, covered with a slight coat of mail, we may proceed to others, more thickly defended, and more formidably armed, whose exact station in the scale of fishes is not yet ascertained. While Linnæus ranks them among the cartilaginous kinds, a later naturalist places them among the spinous class. With which tribe they most agree, succeeding observations must determine. At present we seem better acquainted with their figure than their history: their deformity is obvious; and the venomous nature of the greatest number has been confirmed by fatal experience. This circumstance, as well as the happy distance at which they are placed from us, being all found in the Oriental or American seas, may have prevented a more critical inquiry; so that we know but little of the nature of their malignity, and still less of their pursuits and enmities in the deep.

In the first of this tribe we may place the Sea Orb, which is almost round, has a mouth like a frog, and is from seven inches to two feet long. Like the porcupine, from whence it sometimes takes its name, being also called the Sea Porcupine, it is covered over with long thorns or prickles, which point on every side; and when the animal is enraged, it can blow up its body as round as a bladder. Of this extraordinary creature there are many kinds; some threatening only with spines, as the Sea Hedgehog; others defended with a bony helmet that covers the head, as the Ostracion; others with a coat of mail from the head to the tail, where it terminates in a point, as the Centriscus; and others still, armed offensively and defensively with bones and spines, as the Shield Orb.

Of these scarcely one is without its peculiar weapon of offence. The centriscus wounds with its spine; the ostracion poisons with its venom; the orb is impregnable, and is absolutely poisonous if eaten. Indeed, their figure is not such as would tempt one to make the experiment; and the natives of those countries where they are found, are careful to inform foreigners of their danger: yet a certain sailor at the Cape of Good Hope, not believing what the Dutch told him concerning their venom, was resolved to make the experiment, and break through a prejudice which he supposed was founded on the animal's deformity. He tried, and eat one: but his rashness cost him his life—he instantly fell sick, and died a few days after.

HIPPORAMPUS.

GLOBE DIADON

These frightful animals are of different sizes; some not bigger than a foot-ball, and others as large as a bushel. They almost all flatten and erect their spines at pleasure, and increase the terrors of their appearance in proportion to the approach of danger. At first they seem more inoffensive, their body oblong, with all their weapons pointing towards the tail; but upon being provoked or alarmed, the body that before seemed small swells to the view, the animal visibly grows rounder and larger, and all its prickles stand upright, and threaten the invader on every side. The Americans often amuse themselves with the barren pleasure of catching these frightful creatures by a line and hook baited with a piece of sea crab. The animal approaches the bait with its spines flattened; but when hooked and stopped by the line, straight all its spines are erected, the whole body being armed in such a manner at all points, that it is impossible to lay hold of it on any part. For this reason it is dragged to some distance from the water, and there it quickly expires. In the middle of the belly of all these there is a sort of bag or bladder filled with air, and by the inflation of which the animal swells itself in the manner already mentioned.

In describing the deformed animals of this class, one is sometimes at a loss whether it be a fish or an insect that lies before him. Thus the hippocampus and the pipe fish bear a strong resemblance to the caterpillar and the worm: while the lesser orb bears some likeness to the class of sea eggs to be described afterwards. I will conclude this account of cartilaginous fishes with the description of an animal which I would scarcely call a fish, but that Father Labat dignifies it with the name. Indeed, this class teems with such a number of odd-shaped animals, that one is prompted to rank every thing extraordinary of the finny species among the number; but besides, Labat says its bones are cartilaginous, and that may entitle it to a place here.

The animal I mean is the Galley Fish, which Linnæus degrades into the insect tribe, under the title of the Medusa, but which I choose to place in this tribe, from its habits, that are somewhat similar. To the eye of an unmindful spectator, this fish seems a transparent bubble swimming on the surface of the sea, or like a bladder variously and beautifully painted with vivid colours, where red and violet predominate, as variously opposed to the beams of the sun. It is however an actual fish, the body of which is composed of cartilages, and a very thin skin filled with air, which thus keeps the animal floating on the surface, as the waves and the winds happen to drive. Sometimes it is seen thrown on the shore by one wave, and again washed back into the sea by another. Persons who happen to be walking along the shore often happen to tread upon these animals; and the bursting of their body yields a report like that when one treads upon the swim of a fish. It has eight broad feet with which it swims, or which it expands to catch the air as with a sail. It fastens itself to what-

ever it meets by means of its legs, which have an adhesive quality. Whether they move when on shore Labat could never perceive, though he did every thing to make them stir; he only saw that it strongly adhered to whatever substances he applied it. It is very common in America, and grows to the size of a goose egg, or somewhat more. It is perpetually seen floating; and no efforts that are used to hurt it can sink it to the bottom. All that appears above water is a bladder clear and transparent as glass, and shining with the most beautiful colours of the rainbow. Beneath, in the water, are four of the feet already mentioned, that serve as oars, while the other four are expanded above to sail with. But what is most remarkable in this extraordinary creature, is the violent pungency of the slimy substance with which its legs are smeared. If the smallest quantity but touch the skin, so caustic is its quality that it burns it like hot oil dropped on the part affected. The pain is worst in the heat of the day, but ceases in the cool of the evening. It is from feeding on these that he thinks the poisonous quality contracted by some West Indian fish may be accounted for. It is certain these animals are extremely common along all the coasts in the Gulf of Mexico; and whenever the shore is covered with them in an unusual manner, it is considered as a certain forerunner of a storm.

PART III.

OF SPINOUS FISHES.

CHAPTER I.

THE DIVISION OF SPINOUS FISHES.

The third general division of fishes is into that of the Spinous or bony kind. These are obviously distinguished from the rest by having a complete bony covering to their gills; by their being furnished with no other method of breathing but gills only; by their bones, which are sharp and thorny; and their tails, which are placed in a situation perpendicular to the body. This is that class which alone our later naturalists are willing to admit as fishes. The cetaceous class with them are but beasts that have taken up their abode in the ocean; the cartilaginous class are an amphibious band, that are but half denizens of that element: it is fishes of the Spinous kind that really deserve the appellation.

This distinction the generality of mankind will hardly allow; but whatever be the justice of this preference in favour of the spinous class, it is certain that the cetaceous and cartilaginous

classes bear no proportion to them in number. Of the spinous class are already known above four hundred species; so that the numbers of the former are trifling in comparison, and make not above a fifth part of the finny creation.

From the great variety in this class, it is obvious how difficult a task it must have been to describe or remember even a part of what it contains. When six hundred different sorts of animals offer themselves to consideration, the mind is bewildered in the multiplicity of objects that all lay some claim to its attention. To obviate this confusion, systems have been devised, which, throwing several fishes that agree in many particulars into one group, and thus uniting all into so many particular bodies, the mind that was incapable of separately considering each, is enabled to comprehend all when thus offered in larger masses to its consideration.

Indeed, of all the beings in animated nature, fishes most demand a systematical arrangement. Quadrupeds are but few, and can be all known; birds, from their seldom varying in their size, can be very tolerably distinguished without system; but among fishes, which no size can discriminate, where the animal ten inches and the animal ten feet long is entirely the same, there must be some other criterion by which they are to be distinguished; something that gives precision to our ideas of the animal whose history we desire to know.

Of the real history of fishes very little is yet known, but of very many we have full and sufficient accounts as to their external form. It would be unpardonable, therefore, in a history of these animals, not to give the little we do know, and at least arrange our forces, though we cannot tell their destination. In this art of arrangement, Artedi and Linnæus have long been conspicuous: they have both taken a view of the animal's form in different lights, and from the parts which most struck them have founded their respective systems.

Artedi, who was foremost, perceiving that some fishes had hard prickly fins, as the pike; that others had soft pliant ones, as the herring; and that others still wanted that particular fin by which the gills are opened and shut, as the eel, made out a system from these varieties. Linnæus, on the other hand, rejecting this system, which he found liable to too many exceptions, considered the fins, not with regard to their substance, but their position. The ventral fins seem to be the great object of his system: he considers them as in fishes supplying the same offices as feet in quadrupeds; and from their total absence, or from their being situated nearer the head or the tail, in different fishes, he takes the differences of his system.

These arrangements, which are totally arbitrary, and which are rather a method than a science, are always fluctuating, and the last is generally preferred to that which went before. There has lately appeared, however, a system, composed by M. Gouan of

Montpellier, that deserves applause for more than its novelty. It appears to me the best arrangement of this kind that ever was made; and in it the divisions are not only precisely systematical, but in some measure adopted by nature itself. This learned Frenchman has united the systems of Artedi and Linnæus together; and by bringing one to correct the other, has made out a number of tribes, that are marked with the utmost precision. A part of his system, however, we have already gone through in the cartilaginous, or, as he calls a part of them, the *branchiostegous* tribe of fishes. In the arrangement of these I have followed Linnæus, as the number of them was but small, and his method simple. But in that which is more properly called the spinous class of fishes, I will follow M. Gouan's system; the terms of which, as well as of all the former systems, require some explanation. I do not love to multiply the technical terms of a science, but it often happens that names, by being long used, are as necessary to be known as the science itself.

If we consider the substance of the fin of a fish, we shall find it composed, besides the skin, either of straight, hard, pointed, bony prickles or spines, as in the pike; or of soft, crooked, or forked bones, or cartilages, as in the herring. The fish that have bony prickly fins are called Prickly-finned Fish; the latter, that have soft or cartilaginous fins, are called Soft-finned Fish. The prickly-finned fish have received the Greek new-formed name of *Acanthopterigii;* the soft-finned fish have likewise their barbarous Greek name of *Malacopterigii.* Thus far Artedi has supplied M. Gouan with names and divisions. All spinous fish are divided into Prickly-finned fish, and Soft-finned fish.

Again, Linnæus has taught him to remark the situation of the fins; for the ventral or belly fins, which are those particularly to be remarked, are either wholly wanting, as in the eel, and then the fish is called *Apodal,* (a Greek word signifying without feet); or the ventral fins are placed more forward than the pectoral fins, as in the haddock, and then the animal is called a *Jugular* fish; or the ventral fins are placed directly under the pectoral fins, as in the father-lasher, and then it is called a *Thoracic* fish; or, lastly, the ventral fins are placed nearer the tail than the pectoral fins, as in the minnow, and then it is an *Abdominal* fish.

Possessed of these distributions, the French naturalist mixes and unites them into two grand divisions. All the prickly-finned fish make one general division; all the soft-finned fish another. These first are distinguished from each other, as being either *apodal, jugular, thoracic,* or *abdominal.* Thus there are prickly-finned *apodal* fishes, prickly-finned *jugular* fishes, prickly-finned *thoracic* fishes, and prickly-finned *abdominal* fishes. On the other hand, the soft-finned fishes fall under a similar distribution, and make the other general division. Thus there are soft-finned *apodal* fishes, soft-finned *jugular* fishes, soft-finned *thoracic* fishes, and soft-finned *abdominal* fishes. These general characters are strongly

marked, and easily remembered. It only remains, therefore, to divide these into such tribes as are most strongly marked by nature, and to give the distinct characters of each, to form a complete system with great simplicity. This M. Gouan has done; and the tribes into which he has distributed each of these divisions exactly amount to fifty. Thus the reader, who can contain in his memory the characteristic marks of fifty kinds, will have a tolerable idea of the form of every kind of spinous fish. I say, of the form; for as to the history and nature of the animal itself, that can only be obtained by experience and information.

SECTION I.

PRICKLY-FINNED FISHES.

PRICKLY-FINNED APODAL FISH.

1. THE *Trichurus*. The body of a sword-form; the head oblong; the teeth sword-like, bearded near the points; the fore-teeth largest; the fin that covers the gills with seven spines; the tail ending in a point without fins; an inhabitant near the Oriental and American shores; of a silvery white; frequently leaping into the fishermen's boats in China.

2. The *Xiphias* or *Sword-fish*. The body round; the head long; the upper jaw terminating by a long beak, in form of a sword; the fin that covers the gills with six spines; an inhabitant of Europe; an enemy to the whale.

3. The *Ophidium* or *Gilt-head*. The body sword-like; the head blunt; the fin covering the gills with seven spines; the opening of the mouth side-ways; the fins of the back, the anus, and the tail, all joining together; the most beautiful of all fishes, covered over with green, gold, and silver; it is by sailors called the dolphin, and gives chase to the flying-fish.

PRICKLY-FINNED JUGULAR FISH.

4. The *Trachinus* or *Weever*. The body oblong; the head obtuse; the bones covering the gills jagged at the bottom; the fins covering the gills with six spines; the anus near the breast; buries itself in the sands, leaving only its nose out; and if trod upon, immediately strikes with the spines that form its dorsal fins, which are venomous and dangerous.

6. The *Uranoscopus*. The body wedge-like; the head almost round, and larger than the body; the mouth flat; the eyes on the top of the head; the fin covering the gills with six spines; the anus in the middle of the body; an inhabitant of the Mediterranean Sea.

6. The *Callyonymus* or *Dragonet*. The body almost wedge-like; the head broad, and larger than the body; the mouth even with the body; the bony covering of the gills close shut; the opening to the gills behind the head; the fin covering the gills with six spines; an inhabitant of the Atlantic Ocean.

7. The *Blennius* or *Blenny*. The body oblong; the head obtusely bevil; the teeth a single range; the fin covering the gills with six spines; the ventral fins have two small blunt bones in each; a species of this animal is viviparous.

PRICKLY-FINNED THORACIC FISHES.

8. The *Gobius* or *Gudgeon*. The body round and oblong; the head with two little holes between the eyes, one before the other; the fin covering the gills with four spines; the ventral fins joined together.

9. The *Cepola*. The body sword-like; the head blunt; the mouth flat; the fin covering the gills with six spines; the fins distinct; an inhabitant of the Mediterranean Sea.

10. The *Coryphæna* or *Razor-fish*. The body wedge-like; the head very bevil; the fin covering the gills with five spines.

11. The *Scomber* or *Mackerel*. The body oblong; the line running down the side zigzagged towards the tail; the head sharp and small; the fins covering the gills with seven spines; several false fins towards the tail.

12. The *Labrus* or *Wraisse*. The body oval; the head middling; the lips doubled inward; both cutting and grinding teeth; the covers of the gills scaly, the fin covering the gills generally with five spines; the pectoral fins pointed.

13. The *Sparus* or *Sea-bream*. The body oblong; the head middling; the lips not inverted; the teeth cutting and grinding; the cover of the gills scaly; the fins covering the gills with five rays; the pectoral fins pointed.

14. The *Chætodon* or *Cat-fish*. The body oblong; the head small; the teeth slender and bending; the fin covering the gills with five or six spines; the fins of the back and anus scaly.

15. The *Sciæna*. The body nearly elliptical; the head bevil; the covers of the fins scaly; the fin covering the gills with six rays; the fins of the back jagged, and hidden in a furrow in the back.

16. The *Perch*. The body oblong; the head bevil; the covers of the gills scaly and toothed; the fin covering the gills with seven spines; the fins in some jagged.

17. The *Scorpæna* or *Father-lasher*. The body oblong; the head great, with beards; the covers of the gills armed with prickles; the fin covering the gills with seven spines.

18. The *Mullus* or *Surmulet*. The body slender; the head almost four-cornered; the fin covering the gills with three spines;

some of these have beards; a fish highly prized by the Romans and still considered as a very great delicacy.

19. The *Trigla* or *Gurnard*. The body slender; the head nearly four-cornered, and covered with a bony coat; the fin covering the gills with seven spines; the pectoral and ventral fins strengthened with additional muscles and bones, and very large for the animal's size.

20. The *Cottus* or *Bull-head*. The body wedge-like; the head flat and broader than the body; the fin covering the gills with six spines; the head furnished with prickles, knobs, and beards.

21. The *Zeus* or *Doree*. The body oblong; the head bevil; the fin covering the gills with seven rays; the fins jagged; the upper jaw with a loose floating skin depending into the mouth.

22. The *Thrachipterus* or *Sabre*. The body sword-like; the head bevil; the fin covering the gills with six spines; the lateral line straight; the scales in a single order; a loose skin in both the jaws.

23. The *Gasterosteus* or *Stickleback*. The body broadest towards the tail; the head oblong; the fin covering the gill with three spines; prickles starting backward before the back fins and the fins of the anus.

PRICKLY-FINNED ABDOMINAL FISH.

24. The *Silurus* or *Sheat-fish*. The body oblong; the head large; the fin covering the gills from four to fourteen spines: the leading bones or spines in the back and pectoral fins toothed.

25. The *Mugil* or *Mullet*. The body oblong; the head almost conical; the upper jaw with a furrow, which receives the prominence of the under; the fin covering the gills with seven rays.

26. The *Polynemus*. The body oblong; the head with a beak; the fin covering the gills with from five to seven spines; the bones that move the pectoral fins not articulated to those fins.

27. The *Teuthys*. The body almost elliptical; the head abruptly shortened; the fin covering the gills with five rays; the teeth in a single row, close, strong, and even.

28. The *Elops* or *Sea-serpent*. The body slender; the head large; the fin covering the gills double, with thirty spines, and armed externally with five bones resembling teeth.

SECTION II.

SOFT-FINNED FISHES.

SOFT-FINNED APODAL FISHES.

29. The *Muræna* or *Eel*. The body round and slender; the head terminating in a beak; the fin covering the gills with ten rays; the opening to the gills pipe-fashion, placed near the pectoral fins; the fins of the back, the anus, and the tail, united in one.

30. The *Gymnotus* or *Curapo*. The body broadest on the back, like the blade of a knife; the head small; the fin covering the gills with five rays; the back without a fin; two beards or filaments from the upper lip; an inhabitant of Brazil.

31. The *Anarchicas* or *Wolf-fish*. The body roundish and slender; the head large and blunt; the fore-teeth above and below conical; the grinding teeth and those in the palate round; the fin covering the gill has six rays.

32. The *Stromateus*. The body oblong; the head small; the teeth moderately sharp; the fin covering the gills with five or six rays.

33. The *Ammodytes* or *Launce*. The body slender and roundish; the head terminated by a beak; the teeth of a hair-like fineness; the fin covering the gills with seven rays.

SOFT-FINNED JUGULAR FISHES.

34. The *Lepadogaster*. The body wedge-like; the head oblong, forwarder than the body, flattish, the beak resembling that of a duck; the pectoral fins double, two on each side; the ventral fins joined together; a kind of bony breast-plate between the pectoral fins; the fin covering the gills with five rays; the opening to the gills pipe-fashion.

35. The *Gadus* or *Cod-fish*. The body oblong; the head wedge-like; the fin covering the gills with seven rays; several back and anal fins.

SOFT-FINNED THORACIC FISHES.

36. The *Pleuronectes*. The body elliptical; the head small; both eyes on one side of the head; the fin covering the gills with from four to seven rays.

37. The *Echineis* or *Sucking-fish*. The body almost wedge-like, moderately round; the head broader than the body; the fin covering the gill with ten rays; an oval breast-plate, streaked in form of a ladder, toothed.

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38. The *Lipidopus* or *Garter-fish*. The body sword-like; the head lengthened out; the fins covering the gills with seven rays; three scales only on the whole body; two in the place of the ventral fins; the third from that of the anus.

SOFT-FINNED ABDOMINAL FISH.

39. The *Loricaria*. The body crusted over; the head broad, with a beak; no teeth; the fin covering the gills with six rays.

40. The *Atherina* or *Atherine*. The body oblong; the head of a middling size; the lips indented; the fin covering the gills with six rays: the line on the sides resembling a silver band.

41. The *Salmo* or *Salmon*. The body oblong; the head a little sharp; the fin covering the gills from four to ten rays; the last fin on the back without its correspondent muscle, fat.

42. The *Fistularia*. The body angular, in form of a spindle; the head pipe-fashion, with a beak; the fin covering the gills with seven rays; the under jaw covering the upper.

43. The *Esox* or *Pike*. The body round; the head with a beak; the under jaw pierced longitudinally with small holes; the fin covering the gills from seven to twelve rays.

44. The *Argentina* or *Argentine*. The body a little round and slender; the head with a beak, broader than the body; the fin covering the gills with eight rays; a spurious back fin.

45. The *Clupea* or *Herring*. The body a little oblong; the head with a small beak; the fin covering the gills with eight rays.

46. The *Exocœtus* or *Flying-fish*. The body oblong; the head almost three-cornered; the fin covering the gills with ten rays; the pectoral fins placed high, and as long as the whole body; the back fin at the extremity of the back.

47. The *Cyprinus* or *Carp*. The body elongated, almost round; the head with a small beak; the hinder part of the bone covering the gills marked with a crescent; the fin covering the gills with three rays.

48. The *Cobitis* or *Loach*. The body oblong; almost equally broad throughout; the head small, a little elongated; the eyes in the hinder part of the head; the fin covering the gills from four to six rays; the covers of the gills closed below.

49. The *Amia* or *Bonito*. The body round and slender; the head, forehead, and breast, without skin; the fin covering the gills with twelve rays; two beards from the nose.

50. The *Mormyrus*. The body oblong; the head elongated; the fin covering the gills with a single ray; the opening to the gills is linear, and has no bone covering them.

Such is the system of M. Gouan; by reducing to which any fish that offers, we can know its rank, its affinities, and partly its anatomy, all which make a considerable part in its natural history. But to show the use of this system still more apparently, suppose I meet with a fish, the name to me unknown, of which I desire to

know something more. The way is first to see whether it be a cartilaginous fish, which may be known by its wanting fins to open and shut the gills, which the cartilaginous kinds are wholly without. If I find that it has them, then it is a spinous fish; and, in order to know its kind, I examine its fins, whether they be prickly or soft: I find them soft; it is therefore to be ranked among the soft-finned fishes. I then examine its ventral or belly fins, and finding that the fish has them, I look for their situation, and find they lie nearer to the tail than the pectoral fins. By this I find the animal to be a soft-finned abdominal fish. Then, to know which of the kinds of these fishes it is, I examine its figure and the shape of its head, I find the body rather oblong; the head with a small beak; the lower jaw like a saw; the fin covering the gills with eight rays. This animal must therefore be the herring or one of that family, such as the pilchard, the sprat, the shad, or the anchovy. To give another instance: Upon examining the fins of a fish to me unknown, I find them prickly; I then look for the situation of the ventral fins, I find them entirely wanting; this then must be a prickly-finned apodal fish. Of this kind there are but three; and by comparing the fish with the description, I find it either of the trichurus kind, the sword-fish, or the gilt-head. Upon examining also its external structure, I shall find a very great similitude between my fish and that placed at the head of the family.

CHAPTER II.

OF SPINOUS FISHES IN GENERAL.

Having given a method by which spinous fishes may be distinguished from each other, the history of each in particular might naturally be expected to follow; but such a distinct account of each would be very disgusting, from the unavoidable uniformity of every description. The history of any one of this class very much resembles that of all the rest: they breathe air and water through the gills; they live by rapine, each devouring such animals as its mouth is capable of admitting; and they propagate, not by bringing forth their young alive, as in the cetaceous tribes, nor by distinct eggs, as in the generality of the cartilaginous tribes, but by spawn, or peas, as they are generally called, which they produce by hundreds of thousands. These are the leading marks that run through their whole history, and which have so much swelled books with tiresome repetition.

It will be sufficient therefore to draw this numerous class into one point of view, and to mark how they differ from the former classes, and what they possess peculiarly striking, so as to distinguish them from each other. The first object that presents itself, and

that by which they differ from all others, is the bones. These, when examined but slightly, appear to be entirely solid; yet when viewed more closely, every bone will be found hollow, and filled with a substance less rancid and oily than marrow. These bones are very numerous and pointed; and, as in quadrupeds, are the props or stays to which the muscles are fixed which move the different parts of the body.

The number of bones in all spinous fishes of the same kind is always the same. It is a vulgar way of speaking to say, that fishes are at some seasons more bony than at others; but this scarcely requires contradiction. It is true, indeed, that fish are at some seasons much fatter than at others; so that the quantity of the flesh being diminished, and that of the bones remaining the same, they appear to increase in number, as they actually bear a greater proportion.

All fish of the same kind, as was said, have the same number of bones: the skeleton of a fish, however irregularly the bones may fall in our way at table, has its members very regularly disposed; and every bone has its fixed place, with as much precision as we find in the orders of a regular fabric. But then spinous fish differ in the number of bones, according to the species; for some have a greater number of fins by which they move in the water. The number in each is always in proportion to the number and size of these fins; for every fish has a regular apparatus of bones and muscles, by which the fins are moved; and all those fish, where they are numerous or large, must, of consequence, be considerably bony. Indeed, in the larger fish, the quantity of flesh is so much, and the bones themselves are so large, that they are easily seen and separated; but in the smaller kinds with many fins, the bones are as numerous as in the great; yet being so very minute, they lurk almost in every part of the flesh, and are dangerous as well as troublesome to be eaten. In a word, those fish which are large, fat, and have few fins, are found to be the least bony; those which are small, lean, and have many fins, are the most bony of all others. Thus, for instance, a roach appears more bony than a carp, because it is leaner and smaller; and it is actually more bony than an eel, because it has a greater number of fins.

As the spinous fish partake less of the quadruped in their formation than any others, so they can bear to live out of their own element a shorter time. In general, when taken out of the water, they testify their change by panting violently and at closer intervals, the thin air not furnishing their gills the proper play; and in a few minutes they expire. Some indeed are more vivacious in air than others; the eel will live several hours out of water; and the carp has been known to be fattened in a damp cellar. The method is by placing it in a net well wrapped up in wet moss, the mouth only out, and then hung up in a vault. The fish is fed with white bread and milk; and the net now and then plunged into the water.

The animal thus managed, has been known not only to live for a fortnight, but to grow exceeding fat, and of a superior flavour. From this it would seem, that the want of moisture in the gills is the chief cause of the death of these animals; and could that be supplied, their lives might be prolonged in the air, almost as well as in their own element.

Yet it is impossible to account for the different operations of the same element, upon animals that, to appearance, have the same conformation. To some fishes, bred in the sea, fresh water is immediate destruction; on the other hand, some fishes that live in our lakes and ponds, cannot bear the salt water. Whence this difference can arise, is not easily to be accounted for. The saline quality of the water cannot properly be given as the cause, since no fishes imbibe any of the sea's saltness with their food, or in respiration. The flesh of all fishes is equally fresh, both in the river and in the saltest depths of the ocean; the salt of the element in which they live no way mixing with their constitution. Whence then is it that animals will live only there, and will quickly expire when carried into fresh water? It may probably arise from the superior weight of the sea water. As from the great quantity of salt dissolved in its composition, it is much heavier than fresh water, so it is probable it lies with greater force upon the organs of respiration, and gives them their proper and necessary play: on the other hand, those fish which are used only to fresh water cannot bear the weight of the saline fluid, and expire in a manner suffocated in the grossness of the strange element.

But though there are some tribes that live only in the sea, and others in fresh water, yet there are some whose organs are equally adapted to either element, and that spend a part of their season in one, and a part in the other. Thus the salmon, the shad, the smelt, and the flounder, annually quit their native ocean, and come up our rivers to deposit their spawn. This seems the most important business of their lives; and there is no danger which they will not encounter, even to the surmounting precipices, to find a proper place for the deposition of their future offspring. The salmon, upon these occasions, is seen to ascend rivers five hundred miles from the sea, and to brave not only the danger of various enemies, but also to spring up cataracts as high as a house. As soon as they come to the bottom of the torrent, they seem disappointed to meet the obstruction, and swim some paces back; they then take a view of the danger that lies before them, survey it motionless for some minutes, advance, and again retreat: till at last summoning up all their force, they take a leap from the bottom, their body straight, and strongly in motion; and thus most frequently clear every obstruction. It sometimes happens, however, that they want strength to make the leap; and then, in our fisheries, they are taken in their descent. But this is one of the smallest dangers that attend these adventuring animals in their progress: numberless are the methods of taking them; as well by

the hook, as by nets, baskets, and other inventions, which it is not our business here to describe. Their capture makes in several countries, a great article of commerce; and being cured in several different manners, either by salting, pickling, or drying, they are sent to all the markets of Europe.

As these mount up the rivers to deposit their spawn, others, particularly the eel, descend the fresh water stream, as Radi assures us, to bring forth their young in the sea. About the month of August, annually, these animals take the opportunity of the most obscure nights, and when the rivers are flooded by accidental rains, seek the ocean. When they have reached the sea, and produced their young, for they are viviparous, they again ascend the stream, at different times as opportunity offers, or as the season is favourable or tempestuous. Their passage begins usually about the end of January, and continues till towards the end of May, when they are taken in the river Arno by millions, and so small that a thousand of them goes to a pound. There is nothing more certain than that they descend in our own rivers after floods, in great abundance, and are thus caught in nets, to very great advantage. They are possessed also of a power of climbing over any obstacle; for, by applying their glutinous and slimy bodies to the surface of the object they desire to surmount, they can thus creep up locks, weirs, and every thing that would prevent their ascending the current of the stream.

But the length of the voyage performed by these fishes, is sport, if compared to what is annually undertaken by some tribes, that constantly reside in the ocean. These are known to take a course of three or four thousand miles in a season; serving for prey to whales, sharks, and numerous flocks of water fowl that regularly wait to intercept their progress. These may be called fish of passage, and bear a strong analogy to birds of passage, both from their social disposition, and the immensity of their numbers. Of this kind are the cod, the haddock, the whiting, the mackerel, the tunny, the herring, and the pilchard. Other fish live in our vicinity, and reside on our coasts all the year round, or keep in the depths of the ocean, and are but seldom seen; but these, at stated seasons, visit their accustomed haunts with regular certainty, generally returning the same week in the succeeding year, and often the same day.

The stated returns, and the regular progress of these fish of passage, is one of the most extraordinary circumstances in the history of nature. What it is that impels them to such distant voyages, what directs their passage, what supports them by the way, and what sometimes prompts them to quit for several seasons one shore for another, and then return to their accustomed harbour; are questions that curiosity may ask, but philosophy can hardly resolve. We must dismiss inquiry, satisfied with the certainty of the facts.

The Cod seems to be the foremost of this wandering tribe, and

is only found in our northern part of the world. This animal's chief place of resort is on the banks of Newfoundland, and the other sand-banks that lie off Cape Breton. That extensive flat seems to be no other than the broad top of a sea mountain, extending for above five hundred miles long, and surrounded with a deeper sea. Hither the cod annually repair in numbers beyond the power of calculation, to feed on the quantity of worms that are to be found there in the sandy bottom. Here they are taken in such quantities that they supply all Europe with a considerable share of provision. The English have stages erected all along the shore for salting and drying them; and the fishermen, who take them with the hook and line, which is their method, draw them in as fast as they can throw out. This immense capture, however, makes but a very small diminution when compared to their numbers; and when their provision there is exhausted, or the season for propagation returns, they go off to the polar seas, where they deposit their roes in full security. From thence want of food forces them, as soon as the first more southern seas are open, to repair southward for subsistence. Nor is this fish an unfrequent visitant upon our shores; but the returns are not so regular, nor does the capture bear any proportion to that at Newfoundland.

The Haddock, the Whiting, and the Mackerel, are thought by some to be driven upon our coasts rather by their fears than their appetites, and it is to the pursuit of the larger fishes we owe their welcome visits. It is much more probable that they come for that food which is found in more plenty near the shore than farther out at sea. One thing is remarkable, that their migrations seem to be regularly conducted. The grand shoal of haddocks that comes periodically on the Yorkshire coasts, appeared there in a body on the 10th of December 1766, and exactly on the same day in the following year. This shoal extended from the shore near three miles in breadth, and in length for more than forty. The limits of a shoal are precisely known; for if the fishermen put down their lines at the distance of more than three miles from shore, they catch nothing but dog-fish—a proof that the haddock is not there.

But of all migrating fish, the Herring and the Pilchard take the most adventurous voyages. Herrings are found in the greatest abundance in the highest northern latitudes. In those inaccessible seas, that are covered with ice for a great part of the year, the herring and pilchard find a quiet and sure retreat from all their numerous enemies: thither neither man, nor their still more destructive enemy, the fin-fish, or the cachalot, dares to pursue them. The quantity of insect food which those seas supply is very great; whence, in that remote situation, defended by the icy rigour of the climate, they live at ease, and multiply beyond expression. From this most desirable retreat Anderson supposes they would never depart, but that their numbers render it necessary for them to migrate, and, as with bees from a hive, they are compelled to seek for other retreats.

For this reason, the great colony is seen to set out from the Icy Sea about the mindle of winter, composed of numbers that if all the men in the world were to be loaded with herrings, they would not carry the thousandth part away. But they no sooner leave their retreats but millions of enemies appear to thin their squadrons. The fin-fish and the cachalot swallow barrels at a yawn; the porpoise, the grampus, the shark, and the whole numerous tribe of dog-fish, find them an easy prey, and desist from making war upon each other: but still more, the unnumbered flocks of sea fowl that chiefly inhabit near the pole, watch the outset of their dangerous migration, and spread extensive ruin.

In this existence, the defenceless emigrants find no other safety but by crowding closer together, and leaving to the outmost bands the danger of being first devoured: thus, like sheep when frighted, that always run together in a body, and each finding some protection in being but one of many that are equally liable to invasion, they are seen to separate into shoals, one body of which moves to the west, and pours down along the coasts of America, as far south as Carolina, and but seldom farther. In Chesapeak Bay, the annual inundation of these fish is so great that they cover the shores in such quantities as to become a nuisance. Those that hold more to the east, and come down towards Europe, endeavour to save themselves from their merciless pursuers by approaching the first shore they can find; and that which first offers in their descent is the coast of Iceland, in the beginning of March. Upon their arrival on that coast, their phalanx, which has already suffered considerable diminutions, is nevertheless of amazing extent, depth, and closeness, covering an extent of shore as large as the island itself. The whole water seems alive, and is seen so black with them to a great distance, that the number seems inexhaustible. There the porpoise and the shark continue their depredations, and the birds devour what quantities they please. By these enemies the herrings are cooped up into so close a body, that a shovel, or any hollow vessel put into the water, takes them up without farther trouble.

That body which comes upon our coasts begins to appear off the Shetland Isles in April. These are the forerunners of the grand shoal which descends in June; while its arrival is easily announced by the number of its greedy attendants, the gannet, the gull, the shark, and the porpoise. When the main body is arrived, its breadth and depth is such as to alter the very appearance of the ocean. It is divided into distinct columns, of five or six miles in length, and three or four broad; while the water before them curls up, as if forced out of its bed. Sometimes they sink for the space of ten or fifteen minutes, then rise again to the surface; and in bright weather reflect a variety of splendid colours, like a field bespangled with purple, gold, and azure.

The fishermen are ready prepared to give them a proper recep-

tion; and by nets made for the occasion, they take sometimes above two thousand barrels at a single draught.

From the Shetland Isles another body of this great army, where it divides, goes off to the western coasts of Ireland, where they meet with a second necessity of dividing. The one takes to the Atlantic, where it is soon lost in that extensive ocean; the other passes into the Irish Sea, and furnishes a very considerable capture to the natives.

In this manner the herrings, expelled from their native seas, seek those bays and shores where they can find food, and the best defence against their unmerciful pursuers of the deep. In general, the most inhabited shores are the places where the larger animals of the deep are the least fond of pursuing, and these are chosen by the herring as an asylum from greater dangers. Thus, along the coasts of Norway, the German shores, and the northern shores of France, these animals are found punctual in their visitations. In these different places they produce their young, which, when come to some degree of maturity, attend the general motions. After the destruction of such numbers, the quantity that attempts to return is but small; and Anderson doubts whether they ever return.

Such is the account given of the migration of these fishes, by one who, of all others, was best acquainted with their history; and yet many doubts arise in every part of the migration. The most obvious which has been made is, that though such numbers perish in their descent from the north, yet, in comparison to those that survive, the account is trifling; and it is supposed, that of those taken by man, the proportion is not one to a million. Their regularly leaving the shore also at a stated time, would imply that they are not in their visits under the impulse of necessity. In fact, there seems one circumstance that shows these animals governed by a choice with respect to the shores they pitch upon, and not blindly driven from one shore to another. What I mean is, their fixing upon some shores for several seasons, or, indeed, for several ages together; and, after having regularly visited them every year, then capriciously forsaking them never more to return. The first great bank for herrings was along the shores of Norway. Before the year 1584, the number of ships from all parts of Europe that resorted to that shore exceeded some thousands. The quantity of herrings that were then assembled there was such, that a man who should put a spear into the water, as Olaus Magnus asserts, would see it stand on end, being prevented from falling. But soon after that period, these animals were seen to desert the Norway shores, and took up along the German coast, where the Hanse towns drove a very great trade by their capture and sale; but, for above a century, the herrings have in a great measure forsaken them, and their greatest colonies are seen in the British Channel, and upon the Irish shores. It is not easy to assign a cause for this

seemingly capricious desertion; whether the number of their finny enemies, increasing along the northern coasts, may have terrified the herring tribe from their former place of resort, or whether the quantity of food being greater in the British Channel, may not allure them thither, is not easy to determine.

The Pilchard, which is a fish differing little from the herring, makes the coast of Cornwall its place of principal resort. Their arrival on that coast is soon proclaimed by their attendants the birds, and the larger fishes; and the whole country prepare to take the advantage of this treasure, providentially thrown before them. The natives sometimes enclose a bay of several miles extent with their nets, called *saines*. To direct them in their operations, there were some years ago (but I believe they are discontinued) several men placed on eminences near the shore, called *huers*, who, with brooms in their hands, gave signals where the nets were to be extended, and where the shoals of fishes lay: this they perceived by the colour of the water, which assumed a tincture from the shoals beneath. By these means they sometimes take twelve or fifteen hundred barrels of pilchards at a draught, and they place them in heaps on the shore. It often happens, that the quantity caught exceeds the salt or the utensils for curing them; and then they are carried off to serve for the purposes of manure. This fishery employs not only great numbers of men at sea, training them to naval affairs, but also numbers of women and children at land, in salting and curing the fish; in making boats, nets, ropes, and casks, for the purposes of taking or fitting them for sale. The poor are fed with the superfluity of the capture; the land is manured with the offals; the merchant finds the gain of commission and honest commerce; the fisherman, a comfortable subsistence from his toil. "Ships," says Dr. Borlase, "are often freighted hither with salt, and into foreign countries with the fish, carrying off at the same time a part of our tin. The usual produce of the number of hogsheads exported for ten years, from 1747 to 1756 inclusive, amounted to near thirty thousand hogsheads each year: every hogshead has amounted, upon an average, to the price of one pound thirteen shillings and threepence. Thus the money paid for pilchards exported, has annually amounted to near fifty thousand pounds."

Whence these infinite numbers are derived, still remains obscure; but it will increase our wonder to be told, that so small a fish as the Stickleback, which is seldom above two inches long, and that one would think could easily find support in any water, is yet obliged to colonize, and leave its native fens in search of new habitations. Once every seventh or eighth year, amazing shoals of these appear in the river Welland, near Spalding, and come up the stream, forming one great column. They are supposed to be multitudes collected in some of the fens, till, overcharged with numbers, they are periodically obliged to migrate. An idea may be had of their numbers, when we are informed, that a man, employed by a farmer to take them for the purpose of manuring his grounds, has got, for

a considerable time, four shillings a-day, by selling them at a half-penny a bushel!

Thus we see the amazing propagation of fishes along our own coasts and rivers; but their numbers bear no proportion to the vast quantities found among the islands of the Indian ocean. The inhabitants of these countries are not under the necessity even of providing instruments for fishing; it is but going down to the shore, and there the fish are found in great numbers in the plashes that still continue to have water in them. In some of these places the quantity is so great, that they are left in shoals on those swamps, dried up by the sun, and their putrefaction contributes to render the country unhealthful.

This power of increasing in these animals exceeds our idea, as it would, in a very short time, outstrip all calculation. A single herring, if suffered to multiply unmolested and undiminished for twenty years, would show a progeny greater in bulk than ten such globes as that we live upon. But happily the balance of nature is exactly preserved, and their consumption is equal to their fecundity. For this reason we are to consider the porpoise, the shark, or the cod-fish, not in the light of plunderers and rivals, but of benefactors to mankind. Without their assistance, the sea would soon become overcharged with the burden of its own production; and that element, which at present distributes health and plenty to the shore, would but load it with putrefaction.

In the propagation of all fish some degree of warmth seems absolutely necessary, not only to their preservation, but to the advancement of their posterity. Their spawn is always deposited in those places where the sun-beams may reach them, either at the bottom of shallow shores, or floating on the surface in deeper waters. A small degree of heat answers all the purposes of incubation, and the animal issues from the eggs in its state of perfect formation, never to undergo any succeeding change.

Yet still I have some doubts whether most fish come from the egg completely formed. We know that in all the frog tribe, and many of the lizard kind, they are produced from the egg in an imperfect form. The tadpole, or young frog, with its enormous head and slender tail, are well known: a species of the lizard also, which is excluded from the shell without legs, only acquires them by degrees, and not till after some time does it put off its serpent form. It is probable that some kinds of fish in like manner suffer a change; and though it be too inconsiderable to strike the fisherman or the inattentive spectator, yet it makes a very material difference to the naturalist, and would perhaps disarrange his most favourite systems. A slight alteration in the fins or bones that cover the gills, would overturn the whole fabric of the most applauded ichthyologist; and yet, as I observed, it is most probable that these minute alterations often take place.

As a proof of this, during the month of July there appear near Greenwich innumerable shoals of small fishes, which are known to

the Londonners by the name of White Bait. It is universally agreed that they are the young of some fish; they are never seen but at this time of the year, and never found to have any roe, a circumstance that proves their not being come to maturity. The quantity is amazing; and the fish that produces them in such numbers must be in plenty, though it is not yet known what that fish is, as they correspond with no other species whatever. They most resemble the smelt in form; and yet they want a fin which that animal is never without. They cannot be the bleak, as they are never found in other rivers where the bleak breeds in great abundance. It is most probable, therefore, that they are the young of some animal not yet come to their perfect form, and therefore reducible to no present system.

The time that spinous fishes continue in the pea is in proportion to the size of the kind. It is a rule that chiefly holds through nature, that the larger the animals are, the longer they continue before exclusion. This, I say, holds generally through all nature, though it is not easy to assign a cause for so well known a truth. It may probably be, that as all large bodies take a longer time to grow hot than small ones, so the larger the egg, the longer influence of vital warmth it requires to reach through all its recesses, and to unfold the dormant springs that wait to be put into motion.

The manner in which the eggs of fishes are impregnated is wholly unknown. All that obviously offers is, that in ponds the sexes are often seen together among the long grass at the edge of the water; that they seem to struggle, and that during this time they are in a state of suffering; they grow thin, they lose their appetite, and their flesh becomes flabby; the scales of some grow rough, and they lose their lustre. On the contrary, when the time of coupling is over, their appetite returns, they re-assume their natural agility, and their scales become brilliant and beautiful.

Although the usual way with spinous fishes is to produce by spawn, yet there are some, such as the eel and the blenny, that are known to bring forth their young alive. Bowlker, who has written a treatise upon fishing, seems to determine the question relative to the viviparous production of eels, upon the authority of one or two credible witnesses. An eel, opened in the presence of several persons of credit, was found to have an infinite number of little creatures, closely wrapt up together in a lump about the size of a nutmeg, which being put in a basin of water, soon separated, and swam about; yet still whether these might not have been worms generated in the animal's body, remains a doubt; for there are scarcely any fishes that are not infested with worms in that manner.*

[* The eel was formerly thought to be oviparous; it is now known that it is viviparous. Mr. Chartwynd observes, that if the aperture under the belly of the eel, which looks red in the month of May, be cut open at that time, the young eels will be seen to come forth alive after the operation.

With respect to the growth of fishes it is observed, that, among carps particularly, the first year they grow to about the size of the leaf of a willow tree; at two years they are about four inches long. They grow but one inch more the third season, which is five inches. Those of four years old are about six inches; and seven after the fifth. From that to eight years old they are found to be large in proportion to the goodness of the pond, from eight to twelve inches. With regard to sea fish, the fishermen assure us, that a fish must be six years old before it is fit to be served up to table. They instance it in the growth of a mackerel. They assure us that those of a year old are as large as one's finger; that those of two years are about twice that length; at three and four years, they are that small kind of mackerel that have neither milts nor roes; and between five and six, they are those full grown fish that are served up to our tables. In the same manner, with regard to flat fishes, they tell us, that the turbot and barbel at one year are about the size of a crown piece; the second year as large as the palm of one's hand; and at the fifth and sixth year they are large enough to be served up to table. Thus it appears that fish are a considerable time in coming to their full growth, and that they are a long time destroyed before it comes to their turn to be destroyers.*

All fish live upon each other in some state of their existence. Those with the largest mouths attack and devour the larger kinds; those whose mouths are less, lie in wait for the smaller fry; and even these chiefly subsist upon spawn. Of those which live in the ocean, of the spinous kinds, the Dorado is the most voracious. This is chiefly found in the tropical climates, and is at once the most active and the most beautiful of the finny region. It is about six feet long; the back all over enamelled with spots of a bluish-green and silver; the tail and fins of a gold colour; and all have a brilliancy of tint, that nothing but nature's pencil can attain to; the eyes are placed on each side of the head, large and beautiful, surrounded with circles of shining gold. In the seas where they are found, these fish are always in motion, and play round ships in full sail with ease and security: for ever either pursuing or pursued, they are seen continually in a state of warfare, either defending themselves against the shark, or darting after the smaller fishes. Of all others, the Flying-fish most abounds in these seas; and as it is a small animal seldom growing above the size of a herring, it is chiefly sought by the dorado. Nature has furnished each respectively with the power of pursuit and evasion. The dorado being above six feet long, yet not thicker than a salmon, and furnished with a full complement of fins, cuts its way through the water with amazing rapidity: on the other hand, the flying-fish is furnished with two pair of fins longer than the body, and these also moved by a stronger set of muscles than any other. This

* Traité des Pêches, par Monsieur Duhamel. Sect. 3. p. 160.

equality of power seems to furnish one of the most entertaining spectacles those seas can exhibit. The efforts to seize on the one side, and the arts of escaping on the other, are perfectly amusing. The dorado is seen upon this occasion darting after its prey, which will not leave the water, while it has the advantage of swimming, in the beginning of the chase. But, like a hunted hare, being tired at last, it then has recourse to another expedient for safety, by flight. The long fins, which began to grow useless in the water, are now exerted in a different manner and different direction to that in which they were employed in swimming: by this means the timid little animal rises from the water, and flutters over its surface for two or three hundred yards, till the muscles employed in moving the wings are enfeebled by that particular manner of exertion. By this time, however, they have acquired a fresh power of renewing their efforts in the water, and the animal is capable of proceeding with some velocity by swimming: still, however, the active enemy keeps it in view, and drives it again from the deep; till, at length, the poor little creature is seen to dart to shorter distances, to flutter with greater effort, and to drop down at last into the mouth of its fierce pursuer. But not the dorado alone, all animated nature seems combined against this little fish, which seems possessed of double powers, only to be subject to greater dangers. For though it should escape from its enemies of the deep, yet the tropic bird and the albatross are for ever upon the wing to seize it. Thus pursued in either element, it sometimes seeks refuge from a new enemy; and it is not unfrequent for whole shoals of them to fall on ship-board, where they furnish man with an object of useless curiosity.

The warfare in fresh water is not carried on with such destructive activity, nor are the inhabitants of that element so numerous. It would seem that there is something more favourable to the fecundity of fishes in the ocean, than in an element less impregnated with salt. It has been the opinion of some philosophers, that all fish are natives of the great reservoir, and that only colonies have been sent up rivers, either through accident or the necessity of procuring subsistence. They have been led to this opinion by the superior fecundity of sea fish, which breed twenty to one; as well as by their superiority in strength and size over those of the same kind found in lakes and rivers. This is a matter too remotely speculative to be worth pursuing; but certain it is, that in fresh water fishes seem to abate much of their courage and rapacity, pursue each other with less violence, and seem to be less powerfully actuated by all their appetites. The greediness with which sea fish devour the bait is prodigious, if compared with the manner they take it in fresh water. The lines of such fishermen as go off to sea, are coarse, thick, and clumsy, compared to what are used by those who fish at land. Their baits are seldom more than a piece of a fish, or the flesh of some quadruped, stuck on the hook in a bungling manner, and scarcely

any art is employed to conceal the deception. But it is otherwise in fresh water: the lines must be drawn to a hair-like fineness; they must be tinctured of the peculiar colour of the stream; the bait must be formed with the nicest art, and even, if possible, to exceed the perfection of nature; yet still the fishes approach it with diffidence, and often swim round it with disdain. The cod on the banks of Newfoundland, the instant the hook, which is only baited with the guts of the animal last taken, is dropped into the water, darts to it at once, and the fishermen have but to pull up as fast as they throw down. But it is otherwise with those who fish in fresh water, they must wait whole hours in fruitless expectation; and *the patience of a fisherman* is proverbial among us.

This comparative neglect of food, which is found in all the tribes of fresh water fishes, renders them less turbulent and less destructive among each other. Of all these, the Pike is the most active and voracious; and our poets, whose business it is to observe the surface of nature, have called it the tyrant of the watery plain. In fact, in proportion to its strength and celerity, the pike does some mischief; but what are its efforts compared to those of the cachalot or the shark? they resemble the petty depredations of a robber, put in competition with the ravages of a conqueror! However, the pike will attack every fish less than itself; and it is sometimes seen choaked by attempting to swallow such as are too large a morsel. It is immaterial of what species the animal it pursues appears to be, whether of another or its own, all are indiscriminately devoured; so that every fish owes its safety to its minuteness, its celerity, or its courage: nor does the pike confine itself to feed on fish and frogs, it will draw down the water-rat and the young ducks as they are swimming about. Gesner tells us of a mule that stooped to drink in the water, when a famished pike that was near seized it by the nose, nor was it disengaged till the beast flung it on shore. So great is their rapacity that they will contend with the otter for his prey, and even endeavour to force it from him. For this reason it is dreaded by all other fish; and the small ones show the same uneasiness and detestation at the presence of their tyrant, as the little birds do at the sight of a hawk or an owl. When the pike lies asleep near the surface, as is frequently the case, the lesser fish are observed to swim around it in vast numbers, with a mixture of caution and terror.

The other tribes of fresh water fish are much inferior to this animal in courage and rapacity: they chiefly subsist upon worms and insects, pursuing them at the bottom, or jumping after them to the surface of the water. In winter also their appetites seem entirely to forsake them; at least they continue in so torpid a state that few baits will tempt them to their destruction. At that season they forsake the shallow water, and seek those deep holes to be found in every river, where they continue for days together without ever appearing to move. The cold seems to affect them;

for they lie close to the bottom, where the water is most warm, and seldom venture out except the day be peculiarly fine, and the shallows at the edges of the stream become tepified by the powerful rays of the sun. Indeed I have been assured, that some fishes may be rendered so torpid by the cold in the northern rivers as to be frozen up in the great masses of ice in which they continue for several months together seemingly without life or sensation, the prisoners of congelation, and waiting the approach of a warmer sun to restore them at once to life and liberty. Thus that cheerful luminary not only distributes health and vegetation to the productions of the earth, but it is ardently sought even by the gelid inhabitants of the water.

As fish are enemies one to another, so each species is infested with worms of different kinds peculiar to itself. The great fish abound with them, and the little ones are not entirely free. These troublesome vermin lodge themselves either in the jaws and the intestines internally, or near the fins without. When fish are healthy and fat they are not much annoyed by them; but in winter, when they are lean or sickly, they then suffer very much.

Nor does the reputed longevity of this class secure them from their peculiar disorders. They are not only affected by too much cold, but there are frequently certain dispositions of the element in which they reside unfavourable to their health and propagation. Some ponds they will not breed in, however artfully disposed for supplying them with fresh recruits of water, as well as provision. In some seasons they are found to feel epidemic disorders, and are dead by the water-side, without any apparent cause; yet still they are animals of all others the most vivacious, and they often live and subsist upon such substances as are poisonous to the more perfect classes of animated nature.

It is not easy to determine whether the poisonous qualities which many of them are found to possess, either when they wound our bodies externally with their spines, or when they are unwarily eaten at our tables, arise from this cause. That numbers of fishes inflict poisonous wounds, in the opinion of many, cannot be doubted. The concurrent testimony of mankind they think sufficient to contradict any reasonings upon this head, taken from anatomical inspection. The great pain that is felt from the sting given by the back fin of the weever, bears no proportion to the smallness of the instrument that inflicts the wound. How the poison is preserved, or how it is conveyed by the animal, it is not in our power to conceive; but its actual existence has often been attested by painful experience. In this instance we must decline conjecture, satisfied with history.

The fact of their being poisonous when eaten is equally notorious, and the cause equally inscrutable. My poor worthy friend Dr. Grainger, who resided for many years at St. Christopher's, assured me, that of the fish caught of the same kind at one end of the

island, some were the best and most wholesome in the world; while others taken at a different end were always dangerous, and most commonly fatal. We have a paper in the Philosophical Transactions, giving an account of the posionous qualities of those found at New Providence, one of the Bahama Islands. The author assures us, that the greater part of the fish of that dreary coast are all of a deadly nature, their smallest effects being, to bring on a terrible pain in the joints, which, if terminating favourably, leaves the patient withou tany appetite for several days after. It is not those of the most deformed figure, or the most frightful to look at, that are alone to be dreaded; all kinds at different times, are alike dangerous; and the same species which has this day served for nourishment, is the next, if tried, found to be fatal!

This noxious quality has given rise to much speculation, and many conjectures. Some have supposed it to arise from the fishes on these shores eating of the manchineel apple, a deadly vegetable poison that sometimes grows pendant over the sea; but the quantity of those trees growing in this manner bears no proportion to the extensive infection of the fish. Labat has ascribed it to their eating the galley-fish, which is itself most potently poisonous: but this only removes our wonder a little farther back; for it may be asked, with as just a cause for curiosity, how comes the galley-fish itself to procure its noxious qualities? Others have ascribed the poison of these fishes to their feeding upon copperas beds; but I do not know of any copperas mines found in America. In short, as we cannot describe the alembic by which the rattle-snake distils its malignity, nor the process by which the scorpion, that lives among roses, converts their sweets to venom, so we cannot discover the manner by which fishes become thus dangerous; and it is well for us of Europe that we can thus wonder in security. It is certain that, with us, if fishes, such as carp or tench, acquire any disagreeable flavour from the lakes in which they have been bred, this can be removed by their being kept some time in finer and better water: there they soon clear away all those disagreeable qualities their flesh had contracted, and become as delicate as if they had been always fed in the most cleanly manner. But this expedient is with us rather the precaution of luxury than the effect of fear: we have nothing to dread from the noxious qualities of our fish, for all the animals our waters furnish are wholesome.

Happy England! where the sea furnishes an abundant and luxurious repast, and the fresh waters an innocent and harmless pastime; where the angler, in cheerful solitude, strolls by the edge of the stream, and fears neither the coiled snake nor the lurking crocodile; where he can retire at night, with his few trouts, to borrow the pretty description of old Walton, to some friendly cottage, where the landlady is good, and the daughter innocent and beautiful; where the room is cleanly, with lavender in the sheets, and twenty ballads stuck about the wall! There he can

enjoy the company of a talkative brother sportsman, have his trouts dressed for supper, tell tales, sing old tunes, or make a catch! There he can talk of the wonders of nature with learned admiration, or find some harmless sport to content him, and pass away a little time, without offence to God, or injury to man!

PART IV.

OF CRUSTACEOUS AND TESTACEOUS FISHES.

CHAPTER I.

THE DIVISION OF SHELL FISH.

In describing the inhabitants of the water, a class of animals occur, that mankind, from the place of their residence, have been content to call fish; but that naturalists, from their formation, have justly agreed to be unworthy of the name. Indeed, the affinity many of this kind bear to the insect tribe, may very well plead for the historian who ranks them rather as insects. However, the common language of a country must not be slightly invaded; the names of things may remain, if the philosopher be careful to give precision to our ideas of them.

There are two classes of animals, therefore, inhabiting the water, which commonly receive the name of fishes, entirely different from those we have been describing, and also very distinct from each other. These are divided by naturalists into Crustaceous and Testaceous animals: both, totally unlike fishes to appearance, seem to invert the order of nature; and as those have their bones on the inside, and their muscles hung upon them for the purposes of life and motion, these, on the contrary, have all their bony parts on the outside, and all their muscles within. Not to talk mysteriously—all who have seen a lobster or an oyster, perceive that the shell in these bears a strong analogy to the bones of other animals, and that by these shells the animal is sustained and defended.

Crustaceous fish, such as the crab and the lobster, have a shell, not quite of a stony hardness, but rather resembling a firm crust, and in some measure capable of yielding. Testaceous fishes, such as the oyster or cockle, are furnished with a shell of a stony hardness, very brittle, and incapable of yielding. Of the crustaceous kinds are the Lobster, the Crab, and the Tortoise: of the testaceous, that numerous tribe of Oysters, Muscles, Cockles, and Sea Snails, which offer with infinite variety.

The crustaceous tribe seems to hold the middle rank between fishes, properly so called, and those snail-like animals that receive the name of testaceous fishes. Their muscles are strong and firm, as in the former; their shell is self-produced, as among the latter. They have motion, and hunt for food with great avidity, like the former: They are incapable of swimming, but creep along the bottom, like the latter: in short, they form the link that unites these two classes that seem so very opposite in their natures.

Of testaceous fishes we will speak hereafter. As to animals of the crustaceous kind, they are very numerous, their figure offers a hundred varieties; but as to their nature, they are obviously divided into two very distinct kinds, differing in their habits and their conformation. The chief of one kind is the Lobster; the chief of the other, the Tortoise. Under the Lobster we rank the Prawn, the Craw Fish, the Shrimp, the Sea Crab, the Land Crab, and all their varieties. Under the Sea Tortoise, the Turtle, the Hawksbill Turtle, the Land Tortoise, and their numerous varieties.

CHAPTER II.

CRUSTACEOUS ANIMALS OF THE LOBSTER KIND.

HOWEVER different in figure the Lobster and the Crab may seem, their manners and conformation are nearly the same. With all the voracious appetites of fishes, they are condemned to lead an insect life at the bottom of the water; and though pressed by continual hunger, they are often obliged to wait till accident brings them their prey. Though without any warmth in their bodies, or even without red blood circulating through their veins, they are animals wonderfully voracious. Whatever they seize upon that has life is sure to perish, though never so well defended; they even devour each other; and to increase our surprise still more, they may, in some measure, be said to eat themselves, as they change their shell and their stomach every year, and their old stomach is generally the first morsel that serves to glut the new.*

The Lobster is an animal of so extraordinary a form, that those who first see it are apt to mistake the head for the tail; but it is soon discovered that the animal moves with its claws foremost; and that the part which plays within itself by joints, like a coat of armour, is the tail. The two great claws are the lobster's instruments of provision and defence: these, by opening like a pair of nippers, have great strength, and take a firm hold; they are usually notched like a saw, which still more increases their tena-

[* That lobsters and crabs change their shells annually, is well known; but it is not yet ascertained that they also change their stomachs.]

city. Besides these powerful instruments, which may be considered as arms, the lobster has eight legs, four on each side; and these, with the tail, serve to give the animal its progressive and sideling motion. Between the two claws is the animal's head, very small, and furnished with eyes that seem like two black horny specks on each side; and these it has a power of advancing out of the socket, and drawing in at pleasure. The mouth, like that of insects, opens the long way of the body; not crossways as with man and the higher race of animals. It is furnished with two teeth for the comminution of its food; but as these are not sufficient, it has three more in the stomach, one on each side and the other below. Between the two teeth there is a fleshy substance, in the shape of a tongue. The intestines consist of one long bowel, which reaches from the mouth to the vent; but what this animal differs in from all others is, that the spinal marrow is in the breast-bone. It is furnished with two long feelers or horns that issue on each side of the head, that seem to correct the dimness of its sight, and apprize the animal of its danger or of its prey. The tail, or that jointed instrument at the other end, is the grand instrument of motion, and with this it can raise itself in the water. Under this we usually see lodged the spawn in great abundance, every pea adhering to the next by a very fine filament, which is scarcely perceivable. The ovary, or place where the spawn is first produced, is backwards, towards the tail, where a red substance is always found, and which is nothing but a cluster of peas, that are yet too small for exclusion. From this receptacle there go two canals, that open on each side at the junctures of the shell, at the belly; and through these passages the peas descend to be excluded, and placed under the tail, where the animal preserves them from danger for some time, until they come to maturity; when, being furnished with limbs and motion, they drop off into the water.

When the young lobsters leave the parent, they immediately seek for refuge in the smallest clefts of rocks, and in such-like crevices at the bottom of the sea, where the entrance is but small, and the opening can be easily defended. There, without seeming to take any food, they grow larger in a few weeks' time, from the mere accidental substances which the water washes to their retreats. By this time also they acquire a hard, firm shell, which furnishes them with both offensive and defensive armour. They then begin to issue from their fortresses, and boldly creep along the bottom, in hopes of meeting with more diminutive plunder. The spawn of fish, the smaller animals of their own kind, but chiefly the worms that keep at the bottom of the sea, supply them with plenty. They keep in this manner close among the rocks, busily employed in scratching up the sand with their claws for worms, or surprising such heedless animals as fall within their grasp: thus they have little to apprehend, except from each other; for in them,

as among fishes, the large are the most formidable of all other enemies to the small.

But this life of abundance and security is soon to have a most dangerous interruption; for the body of the lobster still continuing to increase, while the shell remains unalterably the same, the animal becomes too large for its habitation, and, imprisoned within the crust that has naturally gathered round it, there comes on a necessity of getting free. The young of this kind, therefore, that grow faster, as I am assured by the fishermen, change their shell oftener than the old, who come to their full growth, and who remain in the same shell often for two years together. In general, however, all these animals change their shell once a-year; and this is not only a most painful operation, but also subjects them to every danger. Their moulting season is generally about the beginning of summer, at which time their food is in plenty, and their strength and vigour in the highest perfection. But soon all their activity ceases; they are seen forsaking the open parts of the deep, and seeking some retired situation among the rocks, or some outlet where they may remain in safety from the attacks of their various enemies. For some days before their change, the animal discontinues its usual voraciousness; it is no longer seen laboriously harrowing up the sand at the bottom, or fighting with others of its kind, or hunting its prey; it lies torpid and motionless, as if in anxious expectation of the approaching change. Just before casting its shell, it throws itself upon its back, strikes its claws against each other, and every limb seems to tremble; its feelers are agitated, and the whole body is in violent motion; it then swells itself in an unusual manner, and at last the shell is seen beginning to divide at its junctures; particularly it opens at the junctures of the belly, where, like a pair of jumps, it was before but seemingly united. It also seems turned inside out, and its stomach comes away with its shell. After this, by the same operation, it disengages itself of the claws, which burst at the joints; the animal, with a tremulous motion, casting them off as a man would kick off a boot that was too big for him.

Thus, in a short time, this wonderful creature finds itself at liberty, but in so weak and enfeebled a state, that it continues for several hours motionless. Indeed, so violent and painful is the operation, that many of them die under it; and those which survive are in such a weakly state for some time, that they neither take food nor venture from their retreats. Immediately after this change, they have not only the softness, but the timidity of a worm. Every animal of the deep is then a powerful enemy, which they can neither escape nor oppose; and this, in fact, is the time when the dog-fish, the cod, and the ray, devour them by hundreds. But this state of defenceless imbecility continues for a very short time: the animal, in less than two days, is seen to have the skin that covered its body grown almost as hard as before; its appetite

is seen to increase; and, strange to behold! the first object that tempts its gluttony is its own stomach, which it so lately was disengaged from. This it devours with great eagerness, and some time after eats even its former shell. In about forty-eight hours, in proportion to the animal's health and strength, the new shell is perfectly formed, and as hard as that which was but just thrown aside.

To contribute to the speedy growth of the shell, it is supposed by some that the lobster is supplied with a very extraordinary concretion within its body, that is converted into the shelly substance. It is a chalky substance, found in the lower part of the stomach of all lobsters, improperly called crab's eyes, and sold under that title in the shops. About the time the lobster quits its shell, the teeth in its stomach break these stones to pieces, and the fluids contained therein dissolve them. This fluid, which still remains in the new stomach, is thought to be replete with a petrifying quality, proper for forming a new shell: however, the concreting power that first formed these, shows a sufficient power in the animal to produce also the shell; and it is going but a short way in the causes of things, when we attempt to explain one wonder by another.

When the lobster is completely equipped in its new shell, it then appears how much it has grown in the space of a very few days: the dimensions of the old shell being compared with those of the new, it will be found that the creature is increased above a third in its size; and, like a boy that has outgrown his clothes, it seems wonderful how the deserted shell was able to contain so great an animal as entirely fills up the new.

The creature thus furnished, not only with a complete covering, but also a greater share of strength and courage, ventures more boldly among the animals at the bottom; and not a week passes that in its combats it does not suffer some mutilation. A joint, or even a whole claw, is sometimes snapped off in these encounters. At certain seasons of the year these animals never meet each other without an engagement. In these, to come off with the loss of a leg, or even a claw, is considered as no great calamity; the victor carries off the spoil to feast upon at leisure, while the other retires from the defeat to wait for a thorough repair. This repair it is not long in procuring. From the place where the joint of the claw was cut away, is seen in a most surprising manner to bourgeon out the beginning of a new claw. This, if observed, at first is small and tender, but grows, in the space of three weeks, to be almost as large and as powerful as the old one. I say almost as large, for it never arrives to the full size; and this is the reason we generally find the claws of lobsters of unequal magnitude.

After what has been thus described, let us pause a little to reflect on the wonders this extraordinary creature offers to our imagination! An animal without bones on the inside, yet furnished with a stomach capable of digesting the hardest substances, the

shells of muscles, of oysters, and even its own! An animal gaining a new stomach and a new shell at stated intervals! Without red blood circulating through the body, and yet apparently vigorous and active! But, most strange of all, an animal endowed with a vital principle that furnishes out such limbs as have been cut away, and keeps it continually combating, though in constant repair to renew its engagements! These are but a small part of the wonders of the deep, where nature sports without a spectator.

Of this extraordinary, yet well-known animal, there are many varieties, with some differences in the claws, but little in the habits or conformation. It is found above three feet long; and if we may admit the shrimp and the prawn into the class, though unfurnished with claws, it is seen not above an inch. These all live in the water, and can bear its absence for but a few hours. The shell is black when taken out of the water, but turns red by boiling. The most common way of taking the lobster is in a basket or pot, as the fishermen call it, made of wicker-work, in which they put the bait, and then throw it to the bottom of the sea, in six or ten fathoms water. The lobsters creep into this for the sake of the bait, but are not able to get out again. The river craw-fish differs little from the lobster, but that the one will live only in fresh water, and the other will thrive only in the sea.

The Crab is an animal found equally in fresh and salt water, as well upon land as in the ocean. In shape it differs very much from the lobster, but entirely resembles it in habits and conformation. The tail in this animal is not so apparent as in the former, being that broad flap that seems to cover a part of the belly, and when lifted, discovers the peas or spawn, situated there in great abundance. It resembles the lobster in the number of its claws, which are two, and its legs, which are eight, four on either side. Like the lobster, it is a bold, voracious animal; and such an enmity do crabs bear each other, that those who carry them for sale to market, often tie their claws with strings to prevent their fighting and maiming themselves by the way. In short, it resembles the lobster in every thing but the amazing bulk of its body compared to the size of its head and the length of its intestines, which have many convolutions.

As the crab, however, is found upon land as well as in water, the peculiarity of its situation produces a difference in its habitudes, which it is proper to describe. The Land Crab is found in some of the warmer regions of Europe, and in great abundance in all the tropical climates in Africa and America. They are of various kinds and endued with various properties; some being healthful, delicious and nourishing food, others poisonous or malignant to the last degree; some are not above half an inch broad, others are found a foot over; some are of a dirty brown, and others beautifully mottled. That animal called the Violet Crab of the Carribee Islands, is the most noted both for its shape, the delicacy of its flesh, and the singularity of its manners.

The Violet Crab somewhat resembles two hands cut through the middle and joined together; for each side looks like four fingers, and the two nippers or claws resemble the thumbs. All the rest of the body is covered with a shell as large as a man's hand, and bunched in the middle, on the fore part of which there are two long eyes of the size of a grain of barley, as transparent as crystal and as hard as horn. A little below these is the mouth, covered with a sort of barbs, under which there are two broad sharp teeth as white as snow. They are not placed as in other animals, crossways, but in the opposite direction, not much unlike the blades of a pair of scissars. With these teeth they can easily cut leaves, fruits, and rotten wood, which is their usual food. But their principal instrument for cutting and seizing their food is their nippers, which catch such a hold, that the animal loses the limb sooner than its grasp, and is often seen scampering off, having left its claw still holding fast upon the enemy. The faithful claw seems to perform its duty, and keeps for above a minute fastened upon the finger, while the crab is making off.* In fact it loses no great matter by leaving a leg or an arm, for they soon grow again, and the animal is found as perfect as before.

This, however, is the least surprising part of this creature's history; and what I am going to relate, were it not as well known and as confidently confirmed as any other circumstance in natural history, might well stagger our belief. These animals live not only in a kind of orderly society in their retreats in the mountains, but regularly once a year march down to the sea-side in a body of some millions at a time. As they multiply in great numbers, they choose the months of April or May to begin their expedition, and then sally out by thousands from the stumps of hollow trees, from the clefts of rocks, and from the holes which they dig for themselves under the surface of the earth. At that time the whole ground is covered with this band of adventurers; there is no setting down one's foot without treading upon them.† The sea is their place of destination, and to that they direct their march with right-lined precision. No geometrician could send them to their destined station by a shorter course; they neither turn to the right nor left, whatever obstacles intervene; and even if they meet with a house, they will attempt to scale the walls to keep the unbroken tenor of their way. But though this be the general order of their route, they upon other occasions are compelled to conform to the face of the country; and if it be intersected by rivers, they are then seen to wind along the course of the stream. The procession sets forward from the mountains with the regularity of an army under the guidance of an experienced commander. They are commonly divided into three battalions; of which the first consists of the strongest and boldest males, that, like pioneers, march forward to clear the route and face the greatest dangers. These are often

* Brown's Jamacia, p. 423.

† Labat, Voyage aux Isles Françoises, vol. ii. p. 221.

obliged to halt for want of rain, and go into the most convenient encampment till the weather changes. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time, and then descend by regular battalia, being formed into columns of fifty paces broad, and three miles deep, and so close that they almost cover the ground. Three or four days after this the rear-guard follows; a straggling undisciplined tribe, consisting of males and females, but neither so robust nor so numerous as the former. The night is their chief time of proceeding; but if it rains by day, they do not fail to profit by the occasion, and they continue to move forward in their slow uniform manner. When the sun shines and is hot upon the surface of the ground, they then make an universal halt, and wait till the cool of the evening. When they are terrified, they march back in a confused disorderly manner, holding up their nippers, with which they sometimes tear off a piece of the skin, and then leave the weapon where they inflicted the wound. They even try to intimidate their enemies, for they often clatter their nippers together, as if it were to threaten those that come to disturb them. But though they thus strive to be formidable to man, they are much more so to each other; for they are possessed of one most unsocial property, which is, that if any of them by accident is maimed in such a manner as to be incapable of proceeding, the rest fall upon and devour it on the spot, and then pursue their journey.

When after a fatiguing march, and escaping a thousand dangers (for they are sometimes three months in getting to the shore), they have arrived at their destined port, they prepare to cast their spawn. The peas are as yet within their bodies, and not excluded, as is usual in animals of this kind, under the tail; for the creature waits for the benefit of the sea water to help the delivery. For this purpose, the crab has no sooner reached the shore, than it eagerly goes to the edge of the water, and lets the waves wash over its body two or three times. This seems only a preparation for bringing the spawn to maturity; for without farther delay they withdraw to seek a lodging upon land: in the mean time the spawn grows larger, is excluded out of the body, and sticks to the barbs under the flap, or more properly the tail. This bunch is seen as big as a hen's egg, and exactly resembling the roes of herrings. In this state of pregnancy, they once more seek the shore for the last time, and shaking off their spawn into the water, leave accident to bring it to maturity. At this time whole shoals of hungry fish are at the shore in expectation of this annual supply; the sea to a great distance seems black with them, and about two thirds of the crabs' eggs are immediately devoured by these rapacious invaders. The eggs that escape are hatched under the sand; and soon after millions at a time of these little crabs are seen quitting the shore, and slowly travelling up to the mountains.

The old ones, however, are not so active to return; they have become so feeble and lean, that they can hardly creep along, and

the flesh at that time changes its colour. The most of them, therefore, are obliged to continue in the flat parts of the country, till they recover, making holes in the earth, which they cover at the mouth with leaves and dirt, so that no air may enter. There they throw off their old shells, which they leave as it were quite whole, the place where they opened on the belly being unseen. At that time they are quite naked, and almost without motion, for six days together, when they become so fat as to be delicious food. They have then under their stomachs four large white stones, which gradually decrease in proportion as the shell hardens, and, when they come to perfection, are not to be found. It is at that time that the animal is seen slowly making its way back; and all this is most commonly performed in the space of six weeks.

This animal when possessed of its retreats in the mountains is impregnable; for only subsisting upon vegetables, it seldom ventures out; and its habitation being in the most inaccessible places, it remains for a great part of the season in perfect security. It is only when impelled by the desire of bringing forth its young, and when compelled to descend into the flat country, that it is taken. At that time the natives wait for its descent in eager expectation, and destroy thousands; but disregarding the bodies, they only seek for that small spawn which lies on each side of the stomach within the shell, of about the thickness of a man's thumb. They are much more valuable upon their return, after they have cast their shell; for being covered with a skin resembling soft parchment, almost every part except the stomach may be eaten. They are taken in their holes by feeling for them in the ground with an instrument; they are sought after by night, when on their journey, with flambeaux. The instant the animal perceives itself attacked, it throws itself on its back, and with its claws pinches most terribly whatever it happens to fasten on. But the dexterous crab-catcher takes them by the hinder legs, in such a manner that its nippers cannot touch him, and thus he throws it into his bag. Sometimes also they are caught when they take refuge at the bottom of holes, in rocks by the sea-side, by clapping a stick at the mouth of the hole, which prevents their getting out; and then, soon after, the tide coming enters the hole, and the animal is found upon its retiring drowned in its retreat.

These crabs are of considerable advantage to the natives, and the slaves very often feed entirely upon them. In Jamaica, where they are found in great plenty, they are considered as one of the greatest delicacies of the place. Yet still the eating of them is attended with some danger; for even of this kind many are found poisonous, being fed, as it is thought, upon the manchineel apple; and whenever they are found under that noxious plant, they are always rejected with caution. It is thus with almost all the productions of those luxurious climates: however tempting they may be to the appetite, they but too often are found destructive; and scarce a delicacy among them that does not carry its own alloy.

The descent of these creatures for such important purposes deserves our admiration; but there is an animal of the lobster kind that annually descends from its mountains in like manner, and for purposes still more important and various. Its descent is not only to produce an offspring, but to provide itself a covering; not only to secure a family, but to furnish a house. The animal I mean is the Soldier Crab, which has some similitude to the lobster, if divested of its shell. It is usually about four inches long, has no shell behind, but is covered down to the tail with a skin terminating in a point. It is, however, armed with strong hard nippers before, like the lobster; and one of them is as thick as a man's thumb, and pinches most powerfully. It is, as I said, without a shell to any part except its nippers; but what nature has denied this animal, it takes care to supply by art; and taking possession of the deserted shell of some other animal, it resides in it, till, by growing too large for its habitation, it is under the necessity of change. It is a native of the West India Islands; and, like the former, it is seen every year descending from the mountains to the sea-shore, to deposit its spawn, and to provide itself with a new shell. This is a most bustling time with it, having so many things to do; and, in fact, very busy it appears. It is very probable that its first care is to provide for its offspring before it attends to its own wants; and it is thought, from the number of little shells which it is seen examining, that it deposits its spawn in them, which thus is placed in perfect security till the time of exclusion.

However this be, the Soldier is in the end by no means unmindful of itself. It is still seen in its old shell, which it appears to have considerably outgrown; for a part of the naked body is seen at the mouth of it, which the habitation is too small to hide. A shell, therefore, is to be found large enough to cover the whole body, and yet not so large as to be unmanageable and unwieldy. To answer both these ends is no easy matter, nor the attainment of a slight inquiry. The little soldier is seen busily parading the shore along that line of pebbles and shells that is formed by the extremest wave; till, however, dragging its old incommodious habitation at its tail, unwilling to part with one shell, even though a troublesome appendage, till it can find another more convenient. It is seen stopping at one shell, turning it and passing it by, going on to another, contemplating that for a while, and then slipping its tail from its old habitation, to try on the new. This also is found to be inconvenient, and it quickly returns to its old shell again. In this manner it frequently changes, till at last it finds one light, roomy, and commodious; to this it adheres, though the shell be sometimes so large as to hide the body of the animal, claws and all.*

Yet it is not till after many trials, but many combats also, that the soldier is thus completely equipped: for there is often a contest

* Pere du Tertre.

between two of them for some well-looking favourite shell for which they are rivals. They both endeavour to take possession; they strike with their claws, they bite each other, till the weakest is obliged to yield, by giving up the object of dispute. It is then that the victor immediately takes possession, and parades in his new conquest three or four times back and forward upon the strand before his envious antagonist.

When this animal is taken it sends forth a feeble cry, endeavouring to seize the enemy with its nippers; which if it fastens upon, it will sooner die than quit the grasp. The wound is very painful, and not easily cured. For this reason, and as it is not much esteemed for its flesh, it is generally permitted to return to its old retreat in the mountains in safety. There it continues till the necessity of changing once more, and the desire of producing an offspring, expose it to fresh dangers the year ensuing.

BIBLIOTHECA BODLEIANA

CHAPTER III.

OF THE TORTOISE AND ITS KINDS.

HAVING described the lobster and the crab as animals in some measure approaching to the insect tribes, it will appear like injustice to place the Tortoise among the number, that, from its strength, its docility, and the warm red blood that is circulating in its veins, deserves to be ranked even above the fishes. But as this animal is covered, like the lobster, with a shell; as it is of an amphibious nature, and brings forth its young from the egg without hatching; we must be content to degrade it among animals that in every respect it infinitely surpasses.

Tortoises are usually divided into those that live upon land, and those that subsist in the water; and use has made a distinction in the name, the one being called Tortoises, and the other Turtles. However, Seba has proved that all tortoises are amphibious; that the land tortoise will live in the water, and that the sea turtle can be fed upon land. A land tortoise was brought to him, that was caught in one of the canals of Amsterdam, which he kept for half a year in his house, where it lived very well contented in both elements. When in water it remained with its head above the surface; when placed in the sun, it seemed delighted with its beams, and continued immovable while it felt their warmth. The difference, therefore, in these animals, arises rather from their habits than from their conformation; and, upon examination, there will be less variety found between them, than between birds that live upon land and those that swim upon the water.

Yet though nature seems to have made but few distinctions among these animals, as to their conformation, yet in their habits they are very dissimilar, as these result from the different qualities

of their food, and the different sorts of enemies they have to avoid or encounter. I will therefore exhibit their figure and conformation under one common description, by which their slight differences will be more obvious; and then I will give a separate history of the manners of each, as naturalists and travellers have taught us.

All tortoises, in their external form, pretty much resemble each other; their outward covering being composed of two great shells, the one laid upon the other, and only touching at the edges: however, when we come to look closer, we shall find that the upper shell is composed of no less than thirteen pieces, which are laid flat upon the ribs, like the tiles of a house, by which the shell is kept arched and supported. The shells both above and below that, which seem, to an inattentive observer, to make each but one piece, are bound together at the edges by very strong and hard ligaments, yet with some small share of motion. There are two holes at either edge of this vaulted body; one for a very small head, shoulders, and arms, to peep through; the other, at the opposite edge, for the feet and the tail. These shells the animal is never disengaged from; and they serve for its defence against every creature but man.

The tortoise has but a small head with no teeth, having only two bony ridges in the place, serrated and hard. These serve to gather and grind its food; and such is the amazing strength of the jaws, that it is impossible to open them where they have once fastened. Even when the head is cut off the jaws still keep their hold, and the muscles in death preserve a tenacious rigidity. Indeed, the animal is possessed of equal strength in all other parts of its body: the legs, though short, are inconceivably strong; and torpid as the tortoise may appear, it has been known to carry five men standing upon its back with apparent ease and unconcern. Its manner of going forward is by moving its legs one after the other; and the claws with which the toes are furnished sink into the ground like the nails of an iron-shod wheel, and assist its progression.

With respect to its internal parts, not to enter into minute anatomical disquisitions, it may not be improper to observe, that the blood circulates in this animal as in some cartilaginous fishes, and something in the manner of a child in the womb. The greatest quantity of the blood passes directly from the *vena cava*, into the left ventricle of the heart, which communicates with the right ventricle by an opening, while the auricles only receive what the ventricles seem incapable of admitting. Thus the blood is driven by a very short passage through the circulation, and the lungs seem to lend only occasional assistance. From this conformation the animal can subsist for some time without using the lungs or breathing; at least, the lungs are not so necessary an instrument for driving on the circulation as with us.

Such is the general structure of this animal, whether found to live by land or water. With regard to the differences of these animals, the land tortoise, from its habits of making use of its feet in walking, is more nimble upon land than the sea turtle; the land

tortoise, if thrown upon its back, by rocking and balancing its body like a child rocking in a cradle, at last turns itself upon its face again; but the turtle, when once turned, continues without being able to move from the spot. In comparing the feet also of these animals, the nail upon the toes of one that has been long used to scratch for subsistence upon land are blunt and worn; while those that have only been employed in swimming are sharp and long, and have more the similitude of fins. The brain of the land tortoise is but small, and yet it is three times as large as that of the turtle. There is a difference also in the shape of their eggs, and in the passage by which they are excluded; for in the land tortoise the passage is so narrow that the egg conforms to the shape of the aperture, and though round when in the body, yet becomes much more oblong than those of fowls upon being excluded, otherwise they would never be able to pass through the bony canal by which they are protruded: on the contrary, the passage is wider in the turtle, and therefore its eggs are round. These are the most striking distinctions; but that which is most known is their size, the land tortoise often not exceeding three feet long by two feet broad, the sea turtle being sometimes from five to seven feet long. The size, however, is but a fallacious distinction, since land tortoises in some parts of India grow to a very great magnitude, though probably not, as the ancients affirm, big enough for a single shell to serve for the covering of a house.

But if the different kinds of tortoises are not sufficiently distinguished by their figure, they are very obviously distinguishable by their methods of living. The land tortoise lives in holes dug in mountains, or near marshy lakes; the sea turtle in cavities of rocks, and extensive pastures at the bottom of the sea. The tortoise makes use of its feet to walk with, and burrow in the ground; the turtle chiefly uses its feet in swimming, or creeping at the bottom.

The land tortoise is generally found, as was observed above, from one foot to five feet long from the end of the snout to the end of the tail, and from five inches to a foot and a half across the back. It has a small head, somewhat resembling that of a serpent; an eye without the upper lid, the under eye-lid serving to cover and keep that organ in safety. It has a strong scaly tail like the lizard. Its head the animal can put out and hide at pleasure, under the great penthouse of its shell: there it can remain secure from all attacks; there, defended on every side, it can fatigue the patience of the most formidable animal of the forest, that makes use only of natural strength to destroy it. As the tortoise lives wholly upon vegetable food, it never seeks the encounter; yet if any of the smaller animals attempt to invade its repose, they are sure to suffer. The tortoise, impregnably defended, is furnished with such a strength of jaw, though armed with bony plates instead of teeth, wherever it fastens it infallibly keeps its hold, until it has taken out the piece.

Though peaceable in itself, it is formed for war in another respect, for it seems almost endued with immortality. Nothing can kill it; the depriving it of one of its members is but a slight injury; it will live though deprived of the brain, it will live though deprived of its head. Redi informs us, that in making some experiments upon vital motion, he in the beginning of the month of November took a land tortoise, made a large opening in its skull, and drew out all the brain, washed the cavity, so as not to leave the smallest part remaining, and then leaving the hole open, set the animal at liberty. Notwithstanding this, the tortoise marched away without seeming to have received the smallest injury, only it shut the eyes, and never opened them afterwards. Soon after the hole in the skull was seen to close, and in three days there was a complete skin covering the wound. In this manner the animal lived without a brain for six months, walking about unconcernedly, and moving its limbs as before. But the Italian philosopher, not satisfied with this experiment, carried it still farther; for he cut off the head, and the animal lived twenty-three days after its separation from the body. The head also continued to rattle the jaws like a pair of castanets for above a quarter of an hour.

Nor are these animals less long-lived than difficult in destroying. Tortoises are commonly known to exceed eighty years old, and there was one kept in the Archbishop of Canterbury's garden at Lambeth, that was remembered above a hundred and twenty. It was at last killed by the severity of a frost, from which it had not sufficiently defended itself in its winter retreat, which was a heap of sand at the bottom of the garden.

The usual food of the land tortoise seems not so nourishing as to supply this extraordinary principle of vitality. It lives upon vegetables in its retreats in the mountains or the plain, and seldom makes its prey of snails or worms, but when other food is not found in grateful plenty. It is fond also of fruits, and when the forest affords them, is generally found not far from where they grow. As it can move but slowly, it is not very delicate in the choice of its food, so that it usually fills itself with whatever offers. Those that are kept in a domestic state will eat any thing, leaves, fruit, corn, bran, or grass.

From the smallness of its brain, and the slowness of its motion, it obviously appears to be a torpid heavy animal, requiring rest and sleep, and in fact it retires to some cavern to sleep for the winter. I already observed that its blood circulated through the heart by a short passage, and that it did not, as anatomists express it, go through the great circulation. With us and quadrupeds the blood goes from the veins to the heart, from the heart it is sent to be spread over the lungs, from the lungs it returns to the heart again, and from thence it goes to the arteries, to be distributed through the whole body. But its passage in the tortoise is much shorter; for from the veins it goes to the heart, then leaving the lungs entirely out of its course, it takes a short cut, if I may so say, into the beginning of the

arteries, which send it round the animal frame. From hence we see the lungs are left out of the circulation, and consequently the animal is capable of continuing to live without continuing to breathe. In this it resembles the bat, the serpent, the mole, and the lizard: like them, it takes up its dark residence for the winter; and at that time, when its food is no longer in plenty, it happily becomes insensible to the want. Nor is it unmindful to prepare its retreat, and make it as convenient as possible; it is sometimes buried two or three feet in the ground, with its hole furnished with moss, grass, and other substances, as well to keep the retreat warm, as to serve for food in case it should prematurely wake from its state of stupefaction. But it must not be supposed, that while it is thus at rest, it totally discontinues to breathe; on the contrary, an animal of this kind, if put into a close vessel without air, will soon be stifled, though not so readily as in a state of vigour and activity.

From this dormant state the tortoise is awakened by the genial return of spring, and is thought to be much wasted by its long confinement. To animals that live a hundred and fifty years, a sleep of six months is but as the nap of a night. All the actions of these long-lived creatures seem formed upon a scale answering the length of their existence: their slumbers are for a season; their motions are slow, and require time in every action; even the part of procreation, which among other animals is performed in a very few minutes, is with them the business of days. About a month after their enlargement from a torpid state they prepare to transmit their posterity, and both continue joined for near a month together. The eggs of the female are contained in the ovary above the bladder, which is extremely large; and these are before their exclusion round and naked, with some spots of red: after they are laid, however, they assume another form, being smaller and longer than those of a hen. This alteration in the figure of the eggs most probably proceeds from the narrowness of the bony passage through which they are excluded. Swammerdam, who compared the size of the eggs taken out of this animal's body with the diameter of the passage through which they were excluded, was of opinion that the bones themselves separated from each other, and closed again; but, in my opinion, it is more probable to suppose that the eggs, and not the bones, alter their form. Certain it is that they are round in the body, and that they are oval upon being protruded.

The eggs of all the tortoise kind, like those of birds, are furnished with a yolk and a white; but the shell is different, being somewhat like those of soft eggs that hens exclude before their time; however, this shell is much thicker and stronger, and is a longer time in coming to maturity in the womb. The land tortoise lays but a few in number, if compared to the sea turtle, who deposits from a hundred and fifty to two hundred in a season.

The amount of the land tortoise's eggs I have not been able to learn; but from the scarceness of the animal, I am apt to think they cannot be very numerous. When it prepares to lay, the

female scratches a slight depression in the earth, generally in a warm situation, where the beams of the sun have their full effect: there depositing her eggs, and covering them with grass and leaves, she forsakes them to be hatched by the heat of the season. The young tortoises are generally excluded in about twenty-six days; but as the heat of the weather assists, or its coldness retards incubation, sometimes it happens that there is a difference of two or three days. The little animals no sooner leave the egg, than they seek for their provision, entirely self-taught; and their shell with which they are covered from the beginning, expands and grows larger with age. As it is composed of a variety of pieces, they are all capable of extension at their sutures, and the shell admits of increase in every direction. It is otherwise with those animals like the lobster, whose shell is composed all of one piece that admits of no increase, which, when the tenant is too big for the habitation, must burst the shell, and get another. But the covering of the tortoise grows larger in proportion as the internal parts expand; in some measure resembling the growth of the human skull which is composed of a number of bones, increasing in size in proportion to the quantity of the brain. All tortoises, therefore, as they never change their shell, must have it formed in pieces; and though, in some that have been described by painters or historians, these marks have not been attended to, yet we can have no doubt that they are general to the whole tribe.

It is common enough to take these animals into gardens, as they are thought to destroy insects and snails in great abundance. We are even told that, in hot countries, they are admitted into a domestic state, as they are a great destroyer of bugs. How so large and heavy an animal is capable of being expert at such petty prey is not easy to conceive; but I have seen several of them about gentlemen's houses, that, in general, appear torpid, harmless, and even fond of employment. Children have sometimes got upon the back of a tortoise; and such was the creature's strength, that it never seemed overloaded, but moved off with its burden to where it expected to be fed, but would carry them no further. In winter they regularly find out a place to sleep in; but in those warm countries in which the tortoise is found larger, and in greater plenty than in Europe, they live without retiring the whole year round.

The Sea Tortoise, or Turtle, as it is now called, is generally found larger than the former. This element is possessed with the property of increasing the magnitude of those animals which are common to the land and the ocean. The sea pike is larger than that of fresh water; the sea bear is larger than that of the mountains; and the sea turtle exceeds the land tortoise in the same proportion. It is of different magnitudes, according to its different kinds; some turtles being not above fifty pounds weight, and some above eight hundred.

The Great Mediterranean Turtle is the largest of the turtle kind with which we are acquainted. It is found from five to eight feet

long, and from six to nine hundred pounds weight. But unluckily, its utility bears no proportion to its size, as it is unfit for food, and sometimes poisons those who eat it. The shell also, which is a tough strong integument, resembling a hide, is unfit for all serviceable purposes. One of these animals was taken in the year 1729, at the mouth of the Loire, in nets that were not designed for so large a capture. This turtle, which was of enormous strength, by its own struggles involved itself in the nets in such a manner as to be incapable of doing mischief; yet even thus shackled, it appeared terrible to the fishermen, who were at first for flying; but finding it impotent, they gathered courage to drag it on shore, where it made a most horrible bellowing; and when they began to knock it on the head with their gaffs, it was to be heard at half a mile's distance. They were still further intimidated by its nauseous and pestilential breath, which so powerfully affected them that they were near fainting. This animal wanted but four inches of being eight feet long, and was above two feet over: its shell more resembled leather than the shell of a tortoise; and, unlike all other animals of this kind, it was furnished with teeth in each jaw, one rank behind another, like those of a shark: its feet also, different from the rest of this kind, wanted claws; and the tail was quite disengaged from the shell, and fifteen inches long, more resembling that of a quadruped than a tortoise. This animal was then unknown upon the coasts of France; and was supposed to have been brought into the European seas in some India ship, that might be wrecked upon her return. Since that, however, two or three of these animals have been taken upon the coasts; two in particular upon those of Cornwall, in the year 1756, the largest of which weighed eight hundred pounds; and one upon the Isle of Rhé, but two years before that, weighed between seven and eight hundred. One, most probably of this kind also, was caught about thirty years ago near Scarborough, and a good deal of company was invited to feast upon it: a gentleman, who was one of the guests, told the company that it was a Mediterranean turtle, and not wholesome; but a person who was willing to satisfy his appetite at the risk of his life, eat of it: he was seized with a violent vomiting and purging; but his constitution overpowered the malignity of the poison.

These are a formidable and useless kind, if compared to the turtle caught in the South Seas and the Indian Ocean. These are of different kinds; not only unlike each other in form, but furnishing man with very different advantages. They are usually distinguished by sailors into four kinds; the Trunk Turtle, the Loggerhead, the Hawksbill, and the Green Turtle.

The Trunk Turtle is commonly larger than the rest, and its back higher and rounder. The flesh of this is rank, and not very wholesome.

The Loggerhead is so called from the largeness of its head, which is much bigger in proportion than that of the other kinds.

The flesh of this also is very rank, and not eaten but in case of necessity.

The Hawksbill Turtle is the least of the four, and has a long and small mouth, somewhat resembling the bill of a hawk. The flesh of this also is very indifferent eating; but the shell serves for the most valuable purposes. This is the animal that supplies the tortoise-shell, of which such a variety of beautiful trinkets are made. The substance of which the shells of other turtles are composed is thin and porous; but that of the hawksbill is firm, and, when polished, is beautifully marbled. They generally carry about three pounds; but the largest of all, six pounds. The shell consists, as in all the kind, of thirteen leaves or plates, of which eight are flat, and five hollow. They are raised and taken off by means of fire, which is made under the shell, after the flesh is taken out. As soon as the heat affects the leaves, they start from the ribs, and are easily raised with the point of a knife. By being scraped and polished on both sides, they become beautifully transparent; or are easily cast into what form the workman thinks proper, by making them soft and pliant in warm water, and then screwing them in a mould, like a medal: however, the shell is most beautiful before it undergoes this last operation.

But of all animals of the tortoise kind, the Green Turtle is the most noted and the most valuable. The delicacy of its flesh, and its nutritive qualities, together with the property of being easily digested, were, for above a century, known only to our seamen, and the inhabitants of the coasts where they were taken. It was not till by slow degrees the distinction came to be made between such as were malignant and such as were wholesome. The controversies and contradictions of our old travellers were numerous upon this head; some asserting that the turtle was delicious food, and others, that it was actual poison. Dampier, that rough seaman, who has added more to natural history than half of the philosophers that went before him, appears to be the first who informed us of their distinctions; and that while the rest might be valuable for other purposes, the green turtle alone was chiefly prized for the delicacy of its flesh. He never imagined, however, that this animal would make its way to the luxurious tables of Europe; for he seems chiefly to recommend it as salted up for ships' provision, in case of necessity.

At present, the turtle is very well known among us; and is become the favourite food of those that are desirous of eating a great deal without the danger of surfeiting. This is a property the flesh of the turtle seems peculiarly possessed of; and by the importation of it alive among us, gluttony is freed from one of its greatest restraints. The flesh of the turtle is become a branch of commerce: and therefore ships are provided with conveniencies for supplying them with water and provision, to bring them over in health from Jamaica, and other West India islands. This, however, is not always effected; for though they are very vivacious,

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and scarcely require any provision upon the voyage, yet, by the working of the ship, and their beating against the sides of the boat that contains them, they become battered and lean; so that to eat this animal in the highest perfection, instead of bringing the turtle to the epicure, he ought to be transported to the turtle.

This animal is called the green turtle, from the colour of its shell, which is rather greener than that of others of this kind. It is generally found about two hundred weight, though some are five hundred, and others not above fifty. Dampier tells us of one that was seen at Port-Royal, in Jamaica, that was six feet broad across the back: he does not tell us its other dimensions; but says, that the son of Captain Roach, a boy about ten years old, sailed in the shell, as in a boat, from the shore to his father's ship, which was above a quarter of a mile from land. But this is nothing to the size of some turtles the ancients speak of. Ælian assures us, that the houses in the island of Taprobane are usually covered with a single shell. Diodorus Siculus tells us, that a people neighbouring on Ethiopia, called the Turtle eaters, coasted along the shore in boats made of the upper shell of this animal; and that in war, when they had eaten the flesh, the covering served them as a tent. In this account, Pliny, and all the rest of the ancients, agree; and, as they had frequent opportunities of knowing the truth, we are not lightly to contradict their testimony.

At present, however, they are not seen of such amazing dimensions. We are told by Laet, that on the Isle of Cuba they grow to such a size as that five men can stand on the back of one of them together; and, what is more surprisng still, that the animal does not seem overloaded, but will go off with them upon its back, with a slow steady motion, towards the sea.

They are found in the greatest numbers on the Island of Ascension; where, for several years, they were taken to be salted to feed the slaves, or for a supply of ships' provision. Their value at present seems to be better known.

This animal seldom comes from the sea but to deposit its eggs, and now and then to sport in fresh water. Its chief food is a submarine plant, that covers the bottom of several parts of the sea not far from the shore. There the turtles are seen, when the weather is fair, feeding in great numbers, like flocks of sheep, several fathoms deep, upon the verdant carpet below. At other times they go to the mouths of rivers, and they seem to find gratification in fresh water. After some time thus employed, they seek their former stations; and when done feeding, they generally float with their heads above water, unless they are alarmed by the approach of hunters or birds of prey, in which case they suddenly plunge to the bottom. They often seek their provision among the rocks, feeding upon moss and sea-weed; and it is probable will not disdain to prey upon insects and other small animals, as they are very fond of flesh when taken and fed for the table.

At the time of breeding, they are seen to forsake their former haunts and their food, and to take sometimes a voyage of nine hundred miles to deposit their eggs on some favourite shore. The coasts they always resort to upon these occasions are those that are low, flat, and sandy; for being heavy animals, they cannot climb a bold shore, nor is any bed so proper as sand to lay their eggs on. They couple in March, and continue united till May, during a great part of which time they are seen locked together, and almost incapable of separation. The female seems passive and reluctant; but the male grasps her with his claws in such a manner, that nothing can induce him to quit his hold. It would seem that the grasp, as in frogs, is in some measure conclusive, and that the animal is unable to relax its efforts.

When the time for laying approaches, the female is seen, towards the setting of the sun, drawing near the shore, and looking earnestly about her, as if afraid of being discovered. When she perceives any person on shore, she seeks for another place; but if otherwise, she lands when it is dark, and goes to take a survey of the sand where she designs to lay. Having marked the spot, she goes back without laying, for that night, to the ocean again, but the next night returns to deposit a part of her burden. She begins by working and digging in the sand with her fore-feet till she has made a round hole, a foot broad and a foot and a half deep, just at the place a little above where the water reaches highest. This done, she lays eighty or ninety eggs at a time, each as big as a hen's egg, and as round as a ball. She continues laying about the space of an hour; during which time, if a cart were driven over her, she would not be induced to stir. The eggs are covered with a tough white skin, like wetted parchment. When she has done laying, she covers the hole so dexterously, that it is no easy matter to find the place; and those must be accustomed to the search to make the discovery. When the turtle has done laying, she returns to the sea, and leaves her eggs to be hatched by the heat of the sun. At the end of fifteen days she lays about the same number of eggs again; and at the end of another fifteen days she repeats the same; three times in all, using the same precautions every time for their safety.

In about twenty-four or twenty-five days after laying, the eggs are hatched by the heat of the sun; and the young turtles, being about as big as quails, are seen bursting from the sand, as if earth-born, and running directly to the sea, with instinct only for their guide: but, to their great misfortune, it often happens, that their strength being small, the surges of the sea, for some few days, beat them back upon the shore. Thus exposed, they remain a prey to thousands of birds that then haunt the coasts; and these stooping down upon them, carry off the greatest part, and sometimes the whole brood, before they have strength sufficient to withstand the waves, or dive to the bottom. Helbigius informs us, that they have still another enemy to fear, which is no other

than the parent that produced them, that waits for their arrival at the edge of the deep, and devours as many as she can.* This circumstance, however, demands further confirmation; though nothing is more certain than that the crocodile acts in the same unnatural manner.

When the turtles have done laying, they then return to their accustomed places of feeding. Upon their outset to the shore where they breed, they are always found fat and healthy; but upon their return, they are weak, lean, and unfit to be eaten. They are seldom therefore molested upon their retreat; but the great art is to seize them when arrived, or to intercept their arrival. In these uninhabited islands, to which the green turtle chiefly resorts, the men that go to take them land about night-fall, and without making any noise (for those animals, though without any external opening of the ear, hear very distinctly, there being an auditory conduit that opens into the mouth), lie close while they see the female turtle coming on shore. They let her proceed to her greatest distance from the sea; and then, when she is most busily employed in scratching a hole in the sand, they sally out and surprise her. Their manner is to turn her upon her back, which utterly incapacitates her from moving; and yet, as the creature is very strong, and struggles very hard, two men find it no easy matter to lay her over. When thus secured, they go to the next; and in this manner, in less than three hours, they have been known to turn forty or fifty turtles, each of which weighs from a hundred and fifty to two hundred pounds. Labat assures us, that when the animal is in this helpless situation, it is heard to sigh very heavily, and even to shed tears.

At present, from the great appetite that man has discovered for this animal, they are not only thinned in their numbers, but are also grown much more shy. There are several other ways, therefore, contrived for taking them. One is, to seize them when coupled together, at the breeding season, when they are very easily approached, and as easily seen; for these animals, though capable of living for some time under water, yet rise every eight or ten minutes to breathe. As soon as they are thus perceived, two or three people draw near them in a canoe, and slip a noose either round their necks or one of their feet. If they have no line, they lay hold of them by the neck, where they have no shell, with their hands only; and by this means they usually catch them both together. But sometimes the female escapes, being more shy than the male.

Another way of taking them is by the harpoon, either when they are playing on the surface of the water, or feeding at the bottom: when the harpoon is skilfully darted, it sticks fast in the shell of the back; the wood then disengages from the iron, and

[* This account of the Turtle devouring its young, is entirely destitute of foundation.]

the line is long enough for the animal to make its range; for if the harpooner should attempt at once to draw the animal into his boat, till it is weakened by its own struggling, it would probably get free. Thus the turtle struggles hard to get loose, but all in vain; for they take care the line fastened to the harpoon shall be strong enough to hold it.

There is yet another way, which, though seemingly awkward, is said to be attended with very great success. A good diver places himself at the head of the boat; and when the turtles are observed, which they sometimes are in great numbers, asleep on the surface, he immediately quits the vessel at about fifty yards distance, and keeping still under water, directs his passage to where the turtle was seen, and coming up beneath, seizes it by the tail: the animal awaking, struggles to get free; and by this both are kept at the surface until the boat arrives to take them in.

CHAPTER IV.

OF THE SHELL OF TESTACEOUS FISHES.

One is apt to combine very dissimilar objects in the same group, when hurried into the vortex of method. No two animals are more unlike each other than the whale and the limpet, the tortoise and the oyster. Yet, as these animals must find some place in the picture of animated nature, it is best to let them rest in the station which the generality of mankind have assigned them; and as they have been willing to give them all, from their abode, the name of fishes, it is wisest in us to conform.

But before I enter into any history of shell-fish, it may not be improper to observe, that naturalists who have treated on this part of history, have entirely attended to outward forms; and, as in many other instances, forsaking the description of the animal itself, have exhausted all their industry in describing the habitation. In consequence of this radical error, we have volumes written upon the subject of shells, and very little said on the history of shell-fish. The life of these industrious creatures, that for the most part creep along the bottom, or immovably wait till driven as the waves happen to direct, is almost entirely unknown. The wreathing of their shells, or the spots with which they are tinctured, have been described with a most disgusting prolixity; but their appetites and their combats, their escapes, and humble arts of subsistence, have been utterly neglected.

As I have only undertaken to write the history of animated nature, the variety of shells, and their peculiar spots or blemishes, do not come within my design. However, the manner in which shells are formed is a part of natural history connected with my

plan, as it pre-supposes vital force or industry in the animal that forms them.

The shell may be considered as a habitation supplied by nature. It is a hard stony substance, made up somewhat in the manner of a wall. Part of the stony substance the animal derives from outward objects, and the fluids of the animal itself furnish the cement. These united make that firm covering which shell-fish generally reside in till they die.

But in order to give a more exact idea of the manner in which sea shells are formed, we must have recourse to an animal that lives upon land, with the formation of whose shell we are best acquainted. This is the Garden Snail, that carries its box upon its back, whose history Swammerdam has taken such endless pains to describe. As the manner of the formation of this animal's shell extends to that of all others that have shells, whether they live upon land or in water, it will be proper to give it a place before we enter upon the history of Testaceous Fishes.

To begin with the animal in its earliest state, and trace the progress of its shell from the time it first appears:—The instant the young snail leaves the egg, it carries its shell or its box on its back. It does not leave the egg till it is arrived at a certain growth, when its little habitation is sufficiently hardened. This beginning of the shell is not much bigger than a pin's head, but grows in a very rapid manner, having at first but two circumvolutions, for the rest are added as the snail grows larger. In proportion as the animal increases in size, the circumvolutions of the shell increase also, until the number of those volutes come to be five, which is never exceeded.

The part where the animal enlarges its shell is at the mouth, to which it adds in proportion as it finds itself stinted in its habitation below. Being about to enlarge its shell, it is seen with its little teeth biting and clearing away the scaly skin that grows at the edges. It is sometimes seen to eat those bits it thus takes off; at other times it only cleans away the margin when covered with films, and then adds another rim to its shell.

For the purposes of making the shell, which is natural to the animal, and without which it could not live three days, its whole body is furnished with glands, from the orifices of which flows out a kind of slimy fluid, like small spiders' threads, which join together in one common crust or surface, and in time condense and acquire a stony hardness. It is this slimy humour that grows into a membrane and afterwards a stony skin, nor can it have escaped any who have observed the track of a snail: that glistening substance which it leaves on the floor or the wall, is no other than the materials with which the animal adds to its shell, or repairs it when broken.

Now to exhibit in a more satisfactory manner the method in which the shell is formed:—The snail bursts from its egg with its

shell upon its back; this shell, though very simple, is the centre round which every succeeding convolution of the shell is formed, by new circles added to the first. As the body of the snail can be extended no where but to the aperture, the mouth of the shell only can of consequence receive augmentation. The substance of which the shell is composed, is chiefly supplied by the animal itself, and is no more than a slimy fluid which hardens into bone. This fluid passes through an infinite number of little glands, till it arrives at the pores of the skin; but there it is stopped by the shell that covers the part below, and therefore is sent to the mouth of the shell, where it is wanted for its enlargement. There the first layer of slime soon hardens; and then another is added, which hardens also, till in time the shell becomes as thick as is requisite for the animal's preservation. Thus every shell may be considered as composed of a number of layers of slime, which have entirely proceeded from the animal's own body.

But though this be the general opinion with regard to the formation of shells, I cannot avoid thinking there are still other substances beside the animal's own slime which go to the composition of its shell, or at least to its external coat, which is ever different from the internal. The substances I mean are the accidental concretions of earthy or saline parts, which adhere to the slimy matter upon its first emission. By adopting this theory, we can more satisfactorily account for the various colours of the shell, which cannot be supposed to take its tincture from the animal's body, as is the usual opinion, for all the internal parts of the shell are but of one white colour: it is only the outermost layer of the shell that is so beautifully varied, so richly tinctured with that variety of colours we behold in the cabinets of the curious. If the external coat be scaled off, as M. Argenville asserts, all the inner substance will be found but of one simple colouring, and consequently the animal's own juices can give only one colour, whereas we see some shells stained with a hundred.

The usual way of accounting for the different colouring of shells, which seems to be erroneous, is this:—In the body of every one of these animals several streaks are discerned of a different colour from the rest. This variety, say they, is an incontestible proof that the juices flowing from those parts will be also of a different hue, and will consequently tinge that part of the shell which their slime composes of a different colour. But this system, as was observed before, is overthrown by fact, which discovers that only the outer surface of the shell is tinged, whereas by this it would have been coloured throughout; nay, by this system the internal parts of the shell would be stained with the most vivid colouring, as being least exposed to the external injuries of the element where it is placed. But the truth is, the animal residing in the shell has none of these various colours thus talked of: its slime is a simple pellucid substance; and the only marblings which appear in its body are the

colour of the food, which is seen through its transparent intestines. We must therefore account for the various colouring of its shell upon a different principle.

If, as I said, we examine the cabinets of the curious, we shall find shells with various and beautiful colouring; we shall find them generally furnished with a white ground, tinctured with red, yellow, brown, green, and several other shades and lovely mixtures, but never blue. Shells are of almost all colours but blue. The reason seems to be obvious, for blue is the colour which sea water changes. A piece of silk, or a feather of this colour, put into an infusion of salt, urine, or nitre, lose their tint entirely. Now, may not this give us a hint with respect to the operation of nature in colouring her shells? May we not from hence conclude, that sea water is efficacious in giving colour or taking it away? That, to produce colour, the animal not only furnishes its juices, but the sea or the earth that mixture of substance which is to unite with them. Neither the animal slime alone, nor the external earthy or saline substances alone, could produce colours, but both united produce an effect which neither separately was possessed of. Thus shells assume every colour but blue; and that, sea water, instead of producing, would be apt to destroy.

From hence therefore it appears, that the animal does not alone tincture its own shell, but that external causes co-operate in contributing to its beauty. It is probable, that from the nature of its food, or from other circumstances unknown to us, the external layers of its slime may be of different consistencies; so as, when joined with the particles of earth or salt that are accidentally united with them from without, they assume various and beautiful hues. But the internal layers, which receive no foreign admixture, still preserve the natural colour of the animal, and continue white without any variation.

Thus far we see that the animal is not wholly the agent in giving beauty and colouring to its shell; but it seems otherwise with respect to its convolutions, its prominencies, and general form. These entirely depend upon the art of the animal, or rather upon its instincts, which in the same kinds are ever invariable. The shell generally bears some rude resemblance to the body upon which it has been moulded. Thus it is observable in all sea shells, that if the animal has any tumour or excrescence on its body, it creates likewise a swelling in that part of the incrustation to which it corresponds. When the animal begins to alter its position, and to make new additions to its apartments, the same protuberance which had raised the shell before in one part, swells it again at some little distance; by which means we see the same inequality in a spiral line all round the shell. Sometimes these tumours of the animal are so large, or so pointed, that those which rise over them in the incrustation appear like horns: after this the animal disengages itself from its first cavities, and then, by fresh evacuations, assumes a new set of horns; and so increases the number in pro-

portion to its growth. If, on the other hand, the body happens to be channelled, the shell that covers it will be channelled likewise; if there be any protuberances in the body, which wind in a spiral line about it, the shell will likewise have its tumours and cavities winding round to the end.

In this manner, as the animals are of various forms, the shells exhibit an equal variety. Indeed, the diversity is so great, and the figures and colours so very striking, that several persons, with a kind of harmless indolence, have made the arrangement of them the study and the business of their lives. Those who consult their beauty alone, take care to have them polished, and to have an external crust, or periosteum, as Swammerdam calls it, scoured off their surfaces by spirit of salt. But there are others that, with more learned affectation, keep them exactly in the state in which they have been found, with their precious crust still round them. The expence men have been at in making such collections, is amazing; and some shells, such as the Stairs-shell or the Admiral-shell, are not more precious for their scarceness, than pearls are for their beauty. Indeed, it is the scarcity, and not the beauty, of the object, that determines the value of all natural curiosities. Those shells that offer but little beautiful to the ignorant, are often the most precious; and those shells which an unlearned spectator would stop to observe with admiration, one accustomed to the visitation of cabinets, would pass over with disdain. These collections, however, have their use; not only by exhibiting the vast variety of nature's operations, but also by exciting our curiosity to the consideration of the animals that form them. A mind that can find innocent entertainment in these humble contemplations is well employed, and as we say of children, is kept from doing mischief. Although there may be nobler occupations than that of considering the convolutions of a shell, yet there may be some who want the ambition to aspire after such arduous pursuits; there may be some unfit for them; there may be some who find their ambition fully gratified by the praise which the collectors of shells bestow upon each other. Indeed, for a day or two, there is no mind that a cabinet of shells cannot furnish with pleasing employment. What can be more gratifying, as Pliny says,* than to view nature in all her irregularities, and sporting in her variety of shells! Such a difference of colour do they exhibit; such a difference of figure; flat, concave, long, lunated, drawn round in a circle, the orbit cut in two; some are seen with a rising on the back, some smooth, some wrinkled, toothed, streaked, the point variously intortured, the mouth pointing like a dagger, folded back, bent inwards: all these variations, and many more, furnish at once novelty, elegance, and speculation.

With respect to the figure of shells, Aristotle has divided them into three kinds; and his method is, of all others, the most con-

* Plin. ix. 33.

formable to nature. These are, first, the Univalve, or Turbinated, which consist of one piece, like the box of a snail; secondly, the Bivalve, consisting of two pieces, united by a hinge like an oyster; and thirdly, the Multivalve, consisting of more than two pieces, as the acorn shell, which has not less than twelve pieces that go to its composition. All these kinds are found in the sea at different depths, and are valuable in proportion to their scarceness or beauty.

From the variety of the colours and figure of shells, we may pass to that of their place and situation. Some are found in the sea; some in fresh water rivers; some alive upon land; and a still greater quantity dead in the bowels of the earth. But wherever shells are found, they are universally known to be composed of one and the same substance. They are formed of an animal or calcareous earth, that ferments with vinegar and other acids, and that burns into lime, and will not easily melt into glass. Such is the substance of which they are composed; and of their spoils, many philosophers think that a great part of the surface of the earth is composed at present. It is supposed by them, that chalks, marls, and all such earths as ferment with vinegar, are nothing more than a composition of shells, decayed and crumbled down to one uniform mass.

Sea shells are either found in depths of the ocean, or they are cast empty and forsaken of their animals upon shore. Those which are fished up from the deep, are called by the Latin name *Pelagii;* those that are cast upon shore are called *Littorales.* Many of the pelagii are never seen upon shore; they continue in the depths where they are bred, and we owe their capture only to accident. These, therefore, are the most scarce shells, and, consequently, the most valuable. The littorales are more frequent; and such as are of the same kind with the pelagii are not so beautiful. As they are often empty and forsaken, and as their animal is dead, and perhaps putrid in the bottom of the shell, they by this means lose the whiteness and the brilliancy of their colouring. They are not unfrequently also found eaten through, either by worms, or by each other; and they are thus rendered less valuable: but what decreases their price still more is, when they are scaled and worn by lying too long empty at the bottom, or exposed upon the shore. Upon the whole, however, sea shells exceed either land or fossil shells in beauty; they receive the highest polish, and exhibit the most brilliant and various colouring.

Fresh water shells are neither so numerous, so various, nor so beautiful, as those belonging to the sea. They want that solidity which the others have; their clavicle, as it is called, is neither so prominent nor so strong; and, not having a saline substance to tinge the surface of the shell, the colours are obscure. In fresh water there are but two kinds of shells; namely, the bivalved and the turbinated.

Living land shells are more beautiful, though not so various, as those of fresh water, and some not inferior to sea shells in beauty.

These are indeed but of one kind, namely, the turbinated; but in that there are found four or five very beautiful varieties.

Of fossil, or, as they are called, *extraneous* shells, found in the bowels of the earth, there are great numbers, and as great a variety. In this class there are as many kinds as in the sea itself. There are found the turbinated, the bivalve, and the multivalve kinds; and of all these, many are at present not to be found even in the ocean. Indeed, the number is so great, and the varieties so many, that it was long the opinion of naturalists, that they were merely the capricious productions of nature, and had never given retreat to animals whose habitations they resembled. They were found not only of various kinds, but in different states of preservation: some had the shell entire, composed, as in its primitive state, of a white calcareous earth, and filled with earth, or even empty; others were found with the shell entire, but filled with a substance which was petrified by time; others, and these in great numbers, were found with the shell entirely mouldered away, but the petrified substance that filled it still exhibiting the figure of the shell; others still, that had been lodged near earth or stone, impressed their print upon these substances, and left the impression, though they themselves were decayed; lastly, some shells were found half mouldered away, their parts scaling off from each other in the same order in which they were originally formed. However, these different stages of the shell, and even their fermenting with acids, were at first insufficient to convince those who had before assigned them a different origin. They were still considered as accidentally and sportively formed, and deposited in the various repositories where they were found, but no way appertaining to any part of animated nature. This put succeeding inquirers upon more minute researches; and they soon began to find, that often where they dug up petrified shells or teeth, they could discover the petrified remains of some other bony parts of the body. They found that the shells which were taken from the earth exhibited the usual defects and mischances which the same kind are known to receive at sea. They showed them not only tinctured with a salt water crust, but pierced in a peculiar manner by the sea worms, that make the shells of fishes their favourite food. These demonstrations were sufficient at last to convince all but a few philosophers, who died away, and whose erroneous systems died with them.

Every shell, therefore, wherever it is found, is now considered as the spoil of some animal that once found shelter therein. It matters not by what unaccountable means they may have wandered from the sea; but they exhibit all, and the most certain marks of their origin. From their numbers and situation we are led to conjecture, that the sea reached the places where they are found; and from their varieties we learn, how little we know of all the sea contains at present, as the earth furnishes many kinds which our most exact and industrious shell-collectors have not been able to fish up from the deep. It is most probable, that thousands of

different forms still remain at the bottom unknown; so that we may justly say with the philosopher, *Ea quæ scimus sunt pars minima eorum quæ ignoramus.*

It is well, however, for mankind, that the defect of our knowledge on this subject is, of all parts of learning, that which may be most easily dispensed with. An increase in the number of shells would throw but very few lights upon the history of the animals that inhabit them. For such information we are obliged to those men who contemplated something more than the outside of the objects before them. To Reaumur we are obliged for examining the manners of some with accuracy, but to Swammerdam for more. In fact, this Dutchman has lent attention to those animals that almost exceeds credibility: he has excelled even the insects he dissected, in patience, industry, and perseverance. It was in vain that this poor man's father dissuaded him from what the world considered as a barren pursuit; it was in vain that an habitual disorder, brought on by his application, interrupted his efforts; it was in vain that mankind treated him with ridicule while living, as they suffered his works to remain long unprinted and neglected when dead: still the Dutch philosopher went on, peeping into unwholesome ditches, wading through fens, dissecting spiders, and enumerating the blood-vessels of a snail. Like the bee, whose heart he could not only distinguish, but dissect, he seemed instinctively impelled by his ruling passion, although he found nothing but ingratitude from man, and though his industry was apparently becoming fatal to himself. From him I will take some of the leading features in the history of those animals which breed in shells; previously taking my division from Aristotle, who, as was said above, divides them into three classes: the Turbinated, or those of the Snail kind: the Bivalved, or those of the Oyster kind; and the Multivalved, or those of the Acorn-shell kind. Of each I will treat in distinct chapters.

CHAPTER V.

OF TURBINATED SHELL-FISH OF THE SNAIL KIND.

To conceive the manner in which those animals subsist that are hid from us at the bottom of the deep, we must again have recourse to one of a similar nature and formation that we know. The history of the garden snail has been more copiously considered than that of the elephant; and its anatomy is as well if not better known: however, not to give any one object more room in the general picture of nature than it is entitled to, it will be sufficient to observe, that the snail is surprisingly fitted for the life it is formed to lead. It is furnished with the organs of life in a manner almost as complete as the largest animal; with a tongue, brain,

salival ducts, glands, nerves, stomach, and intestines; liver, heart, and blood-vessels: besides this, it has a purple bag that furnishes a red matter to different parts of the body, together with strong muscles that hold it to the shell, and which are hardened, like tendons, at their insertion.

But these it possesses in common with other animals. We must now see what it has peculiar to itself. The first striking peculiarity is, that the animal has got its eyes on the points of its largest horns. When the snail is in motion, four horns are distinctly seen; but the two uppermost and longest deserve peculiar consideration, both on account of the various motions with which they are endued, as well as their having their eyes fixed at the extreme ends of them. These appear like two blackish points at their ends. When considered as taken out of the body, they are of a bulbous or turnip-like figure; they have but one coat; and the three humours which are common in the eyes of other animals, namely, the vitreous, the aqueous, and the crystalline, are in these very indistinctly seen. The eyes the animal can direct to different objects at pleasure, by a regular motion out of the body; and sometimes it hides them by a very swift contraction into the belly. Under the small horns is the animal's mouth; and though it may appear too soft a substance to be furnished with teeth, yet it has not less than eight of them, with which it devours leaves, and other substances, seemingly harder than itself, and with which it sometimes bites off pieces of its own shell.

But what is most surprising in the formation of this animal, are the parts that serve for generation. Every snail is at once male and female, and while it impregnates another, is itself impregnated in turn. The vessels supplying the fluid for this purpose are placed chiefly in the fore-part of the neck, and extend themselves over the body; but the male and female organs of generation are always found united, and growing together. There is a large opening on the right side of the neck, which serves for very different purposes. As an *anus* it gives a passage to the excrements; as a mouth it serves for an opening for respiration; and also an organ of generation, it dilates when the desire of propagation begins. Within this each animal has those parts, or something similar thereto, which continue the kind.

For some days before coition the snails gather together, and lie near each other, eating very little in the mean time; but they settle their bodies in such a posture that the neck and head are placed upright. In the mean time, the apertures on the side of the neck being greatly dilated, two organs resembling intestines are seen issuing from them, which some have thought to be the instruments of generation. Beside the protrusion of these, each animal is possessed of another peculiarity; for from the same aperture they launch forth a kind of dart at each other, which is pretty hard, barbed, and ending in a very sharp point. This is performed when the apertures approach each other; and then the

one is seen to shoot its weapon, which is received by the other, though it sometimes falls to the ground: some minutes after, the snail which received the weapon darts one of its own at its antagonist, which is received in like manner. They then softly approach still nearer, and apply their bodies one to the other, as closely as the palms and fingers of the hands when grasped together. At that time the horns are seen variously moving in all directions, and this sometimes for three days together. The coupling of these animals is generally thrice repeated, at intervals, of fifteen days each, and at every time a new dart is mutually emitted.

At the expiration of eighteen days the snails produce their eggs at the opening of the neck, and hide them in the earth with the greatest solicitude and industry. These eggs are in great numbers, round, white, and covered with a soft shell: they are also stuck to each other by an imperceptible slime, like a bunch of grapes, of about the size of a small pea.

When the animal leaves the egg, it is seen with a very small shell on its back, which has but one convolution; but in proportion as it grows, the shell increases in the number of its circles. The shell always receives its additions at the mouth, the first centre still remaining; the animal sending forth from its body that slime which hardens into a stony substance, and still is fashioned into similar volutions. The garden snail seldom exceeds four rounds and a half; but some of the sea snails arrive even at ten.

The snail thus fitted with his box, which is light and firm, finds itself defended in a very ample manner from all external injury. Whenever it is invaded, it is but retiring into this fortress, and waiting patiently till the danger is over. Nor is it possessed only of a power of retreating into its shell, but of mending it when broken. Sometimes these animals are crushed seemingly to pieces, and to all appearance utterly destroyed; yet still they set themselves to work, and in a few days mend all their numerous breaches. The same substance by which the shell is originally made, goes to the re-establishment of the ruined habitation. But all the junctures are very easily seen, for they have a fresher colour than the rest, and the whole shell in some measure resembles an old coat patched with new pieces. They are sometimes seen with eight or ten of these patches, so that the damage must have been apparently irreparable. Still, however, though the animal is possessed of the power of mending its shell, it cannot when come to its full growth make a new one. Swammerdam tried the experiment: he stripped a snail of its shell, without hurting any of the blood-vessels, retaining that part of the shell where the muscles were inserted; but it died in three days after it was stripped of its covering, not, however, without making efforts to build up a new shell, for before its death it pressed out a certain membrane round the whole surface of its body. This membrane was entirely of the shelly nature, and was intended by the animal as a supply towards a new one.

As the snail is furnished with all the organs of life and sensation, it is not wonderful to see it very voracious. It chiefly subsists upon the leaves of plants and trees, but is very delicate in its choice. When the animal moves to seek its food, it goes forward by means of that broad muscular skin which is sometimes seen projecting round the mouth of the shell; this is expanded before, and then contracted with a kind of undulating motion, like a man attempting to move himself forward by one arm while lying on his belly. But the snail has another advantage, by which it not only smooths and planes its way, but also can ascend in the most perpendicular direction. This is by that slimy substance with which it is so copiously furnished, and which emits wherever it moves. Upon this slime, as upon a kind of carpet, it proceeds slowly along, without any danger of wounding its tender body against the asperities of the pavement; by means of this it moves upwards to its food upon trees, and by this descends, without danger of falling and breaking its shell from the shock.

The appetite of these animals is very great; and the damage gardeners in particular sustain from them, makes them employ every method for their destruction. Salt will destroy them, as well as soot; but a tortoise in a garden is said to banish them much more effectually.

At the approach of winter the snail buries itself in the earth, or retires to some hole, to continue in a torpid state during the severity of the season. It is sometimes seen alone, but more frequently in company in its retreat, several being usually found together apparently deprived of life and sensation. For the purposes of continuing in greater warmth and security, the snail forms a cover or lid to the mouth of its shell with its slime, which stops it up entirely, and thus protects it from every external danger. The matter of which the cover is composed is whitish, somewhat like plaster, pretty hard and solid, yet at the same time porous and thin, to admit air, which the animal cannot live without. When the cover is formed too thick, the snail then breaks a little hole in it, which corrects the defects of that closeness which proceeded from too much caution. In this manner, sheltered in its hole from the weather, defended in its shell by a cover, it sleeps during the winter; and for six or seven months continues without food or motion, until the genial call of spring breaks its slumber, and excites its activity.

The snail having slept for so long a season, wakes one of the first fine days of April, breaks open its cell, and sallies forth to seek for nourishment. It is not surprising that so long a fast should have thinned it, and rendered it very voracious. At first, therefore, it is not very difficult in the choice of its food, almost any vegetable that is green seems welcome; but the succulent plants of the garden are chiefly grateful, and the various kinds of pulse are at some seasons almost wholly destroyed by their numbers. So great is the multiplication of snails in some years,

that gardeners imagine they burst from the earth. A wet season is generally favourable to their production; for this animal cannot bear very dry seasons or dry places, as they cause too great a consumption of its slime, without plenty of which it cannot subsist in health and vigour.

Such are the most striking particulars in the history of this animal; and this may serve as a general picture, to which the manners and habitudes of the other tribes of this class may be compared and referred. These are, the sea-snail, of which naturalists have, from the apparent difference of their shells, mentioned fifteen kinds;* the fresh-water snail, of which there are eight kinds; and the land snail, of which there are five. These all bear a strong resemblance to the garden snail, in the formation of their shell, in their hermaphrodite natures, in the slimy substance with which they are covered, in the formation of their intestines, and the disposition of the hole on the right side of the neck, which serves at once for the discharge of the fæces, for the lodging the instruments of generation, and for respiration, when the animal is under a necessity of taking in a new supply.

But in nature, no two kinds of animals, however like each other in figure or conformation, are of manners entirely the same. Though the common garden snail bears a very strong resemblance to that of fresh water, and that of the sea, yet there are differences to be found, and those very considerable ones.

If we compare them with the fresh water snail, though we shall find a general resemblance, yet there are one or two remarkable distinctions: and first, the fresh water snail, and as I should suppose, all snails that live in water, are peculiarly furnished with a contrivance by nature, for rising to the surface, or sinking to the bottom. The manner in which this is performed, is by opening and shutting the orifice on the right side of the neck, which is furnished with muscles for that purpose. The snail sometimes gathers this aperture into an oblong tube, and stretches or protends it above the surface of the water, in order to draw in or expel the air, as it finds occasion. This may not only be seen, but heard also by the noise which the snail makes in moving the water. By dilating this it rises; by compressing it, the animal sinks to the bottom. This is effected somewhat in the manner in which little images of glass are made to rise or sink in water, by pressing the air contained at the mouth of the tubes, so that it shall drive the water into their hollow bodies, which before were filled only with air, and thus make them heavier than the element in which they swim. In this manner does the fresh water snail dive or swim, by properly managing the air contained in its body.

But what renders these animals far more worthy of notice is, that they are viviparous, and bring forth their young not only alive, but with their shells upon their backs. This seems sur-

* D'Argenville's Conchyliologie.

prising; yet it is incontestibly true. The young come to some degree of perfection in the womb of the parent; there they receive their stony coat; and from thence are excluded, with a complete apparatus for subsistence.

"On the twelfth of March," says Swammerdam, "I began my observations upon this snail, and collected a great number of the kind, which I put into a large basin filled with rain water, and fed for a long time with potter's earth, dissolved in the water about them. On the thirteenth of the same month I opened one of these snails, when I found nine living snails in its womb: the largest of these were placed foremost, as the first candidates for exclusion. I put them into fresh water, and they lived till the eighteenth of the same month, moving and swimming like snails full grown; nay, their manner of swimming was much more beautiful." Thus, at whatever time of the year these snails are opened, they are found pregnant with eggs, or with living snails, or with both together.

This striking difference between the fresh water and the garden snail, obtains also in some of the sea kind; among which there are some that are found viviparous, while others lay eggs in the usual manner. Of this kind are one or two of the Buccinums, within which living young have been frequently found, upon their dissection. In general, however, the rest of this numerous class bring forth eggs; from whence the animal bursts at a proper state of maturity, completely equipped with a house, which the moistness of the element where it resides does not prevent the inhabitant from enlarging. How the soft slime of the snail hardens, at the bottom of the sea, into the stony substance of a shell, is not easy to conceive. This slime must at least be possessed of very powerful petrifying powers.

All animals of the snail kind, as was observed before, are hermaphrodites, each containing the instruments of generation double. But some of the sea kinds copulate in a different manner from those of the garden. The one impregnates the other; but, from the position of the parts, is incapable of being impregnated by the same in turn. For this reason it is necessary for a third to be admitted as a partner in this operation; so that, while one impregnates that before it, another does the same office by this, which is itself impregnated by a fourth. In this manner Mr. Adanson has seen vast numbers of sea snails united together in a chain, impregnating each other. The Bulin and the Coret perform the offices of male and female at the same time. The orifices in these are two, both separate from each other: the opening by which the animal performs the office of the male being at the origin of the horns; that by which it is passive, as the female, being farther down upon the neck. It may also be observed as a general rule, that all animals that have this orifice, or verge, as some call it, on the right side, have their shells turned from the right to the left; on the contrary, those which have it on the left side, have their

shells turned from left to right, in a contrary direction to the former.

But this is not the only difference between land and sea snails. Many of the latter entirely want horns; and none of them have above two. Indeed, if the horns of snails be furnished with eyes, and if, as some are willing to think, the length of the horn, like the tube of a telescope, assists vision, these animals, that chiefly reside in the gloomy bottom of the deep, can have no great occasion for them. Eyes would be unnecessary to creatures whose food is usually concealed in the darkest places; and who, possessed of very little motion, are obliged to grope for what they subsist on. To such, I say, eyes would rather be an obstruction than an advantage; and perhaps even those that live upon land are without them.

Those that have seen the shells of sea snails, need not be told that the animal which produces them is larger than those of the same denomination upon land. The sea seems to have the property of enlarging the magnitude of all its inhabitants; and the same proportion that a trout bears to a shark, is often seen to obtain between a shell bred upon the land and one bred in the ocean. Its convolutions are more numerous. The garden snail has but five turns at the most; in the sea snail the convolutions are sometimes seen amounting to ten.

There is a difference also in the position of the mouth in the garden and the water snail. In the former, the mouth is placed crosswise, as in quadrupeds, furnished with jaw-bones, lips, and teeth. In most of the sea-snails, the mouth is placed longitudinally in the head; and in some obliquely, or on one side. Others, of the Trochus kind, have no mouth whatsoever, but are furnished with a trunk, very long in some kinds, and shorter in others.

Snails of the Trochus kind, furnished thus with an instrument of offence, deserve our particular attention. The trunk of the trochus is fleshy, muscular, supple, and hollow. Its extremity is bordered with a cartilage, and toothed like a saw. The snails that are provided with this, may be considered as the predaceous tribe among their fellows of the bottom. They are, among snails, what the tiger, the eagle, or the shark, is among beast, birds, or fishes. The whole race of shelled animals avoid their approach; for their habitations, however powerfully and strongly built, though ever so well fortified, yield to the superior force of these invaders. Though provided with a thick clumsy shell themselves, yet they move with greater swiftness at the bottom than most other shell-fish, and seize their prey with greater facility. No shell so large but they will boldly venture to attack, and, with their piercing auger-like trunk, will quickly bore it through. No efforts the other animal makes can avail: it expands itself, and rises to the surface, but the enemy rises with it; it again sinks to the bottom, but still its destroyer closely adheres. In this manner the carni-

vorous shell-fish, as some naturalists call it, sticks for several days, nay weeks, to its prey, until with its trunk it has sucked out all substance, or until it drops off when the other begins to putrify.

Thus it would seem throughout nature, that no animal is so well defended but that others are found capable of breaking in upon its intrenchments. The garden snail seems tolerably well guarded; but the wall of its shell is paper itself in comparison with that which fortifies some of the sea snail kind. Beside this thick shell, many of them are also furnished with a lid, which covers the mouth of the shell, and which opens and shuts at the animal's pleasure. When the creature hunts for food, it opens its box, gropes or swims about; and when satisfied, drops its lid and sinks to the bottom: there it might be supposed to remain in perfect security; but the trochus soon finds the way to break into the thickest part of its enclosure, and quickly destroys it with the most fatal industry.

The being liable to the attacks of the trochus seems to be a calamity to which most of this tribe are subject. Scarcely a shell is met with entire and sound to the end of its convolutions; but particularly the thinnest shells are the most subject to be thus invaded. As their shells are easily pierced, the predatory shell-fish, or the sea worm, chiefly seek them for subsistence; and of those thin paper-like shells, not one in a hundred is found that has not suffered some disaster. As they are lighter than other shell-fish, they swim with greater ease; and this is the chief method of avoiding their heavier thick-shelled pursuers. The food of all snails properly lies at the bottom; when, therefore, the nautilus, or other thin-shelled fish, are seen busily swimming at the surface, it may be, that instead of sporting or sunning themselves, as some are apt to suppose, they are actually labouring to escape their most deadly pursuers.

Of all sea snails, that which is most frequently seen swimming upon the surface, and whose shell is the thinnest and most easily pierced, is the Nautilus. Whether upon these occasions it is employed in escaping its numerous enemies at the bottom, or seeking for food at the surface, I will not venture to decide. It seems most probable, that the former is the cause of its frequently appearing; for, upon opening the stomach, it is found to contain chiefly that food which it finds at the bottom. This animal's industry, therefore, may be owing to its fears; and all those arts of sailing which it has taught mankind, may have been originally the product of necessity. But the nautilus is too famous not to demand a more ample description.

Although there be several species of the nautilus, yet they all may be divided into two; the one with a white shell as thin as paper, which it is often seen to quit and again to resume; the other with a thicker shell, sometimes of a beautiful mother-of-pearl colour, and that quits its shell but rarely. This shell outwardly resembles that of a large snail, but is generally six or eight inches

across: within, it is divided into forty partitions, that communicate with each other by doors, if I may so call them, through which one could not thrust a goose quill: almost the whole internal part of the shell is filled by the animal, the body of which, like its habitation, is divided into as many parts as there are chambers in its shell; all the parts of its body communicate with each other, through the doors or openings, by a long blood-vessel, which runs from the head to the tail: thus the body of the animal, if taken out of the shell, may be likened to a number of soft bits of flesh, of which there are forty, threaded upon a string. From this extraordinary conformation, one would not be apt to suppose that the nautilus sometimes quitted its shell, and returned to it again; yet nothing, though seemingly more impossible, is more certain. The manner by which it contrives to disengage every part of its body from so intricate an habitation; by which it makes a substance, to appearance as thick as one's wrist, pass through forty doors, each of which would scarcely admit a goose quill, is not yet discovered: but the fact is certain; for the animal is often found without its shell, and the shell more frequently destitute of the animal. It is most probable, that it has a power of making the substance of one section of its body remove up into that which is next; and thus, by multiplied removals, it gets free.

But this, though very strange, is not the peculiarity for which the nautilus has been the most distinguished. Its spreading the thin oar, and catching the flying gale, to use the poet's description of it, has chiefly excited human curiosity. These animals, particularly those of the white, light kind, are chiefly found in the Mediterranean; and scarcely any who have sailed on that sea, but must often have seen them. When the sea is calm, they are observed floating on the surface; some spreading their little sail; some rowing with their feet, as if for life and death; and others still, floating with their mouths, like a ship with the keel upward. If taken while thus employed, and examined, the extraordinary mechanism of their limbs for sailing will appear more manifest. The nautilus is furnished with eight feet, which issue near the mouth, and may as properly be called barbs; these are connected to each other by a thin skin, like that between the toes of a duck, but much thinner, and more transparent. Of these eight feet thus connected, six are short, and these are held up as sails to catch the wind in sailing; the two others are longer, and are kept in the water, serving, like paddles, to steer their course by. When the weather is quite calm, and the animal is pursued from below, it is then seen expanding only a part of its sail, and rowing with the rest: whenever it is interrupted, or fears danger from above, it instantly furls the sail, catches in all its oars, turns its shell mouth downward, and instantly sinks to the bottom. Sometimes also it is seen pumping the water from its leaking hulk; and when unfit for sailing, deserts its shell entirely. The forsaken hulk is

seen floating along, till it dashes, by a kind of shipwreck, upon the rocks or the shore.

From the above description, I think, we may consider this animal rather as attempting to save itself from the attacks of its destroyers, than as rowing in pursuit of food. Certain it is, that no creature of the deep has more numerous and more powerful enemies. Its shell is scarcely ever found in perfect preservation, but is generally seen to bear some marks of hostile invasion. Its little arts, therefore, upon the surface of the water, may have been given it for protection; and it may thus be endued with comparative swiftness, to avoid the crab, the sea-scorpion, the trochus, and all the slower predaceous reptiles that lurk for it at the bottom of the water.

From this general view of snails, they appear to be a much more active, animated tribe, than from their figure one would at first conceive. They seem, to an inattentive spectator, as mere inert masses of soft flesh, rather loaded than covered with a shell, scarcely capable of motion, and insensible to all the objects around them. When viewed more closely, they are found to be furnished with the organs of life and sensation in tolerable perfection; they are defended with armour that is at once both light and strong; they are as active as their necessities require; and are possessed of appetites more poignant than those of animals that seem much more perfectly formed. In short, they are a fruitful industrious tribe, furnished, like all other animals, with the powers of escape and invasion; they have their pursuits and their enmities, and of all creatures of the deep, they have most to fear from each other.

CHAPTER VI.

OF BIVALVED SHELL-FISH, OR SHELLS OF THE OYSTER KIND.

It may seem whimsical to make a distinction between the animal perfections of turbinated and bivalved shell-fish, or to grant a degree of superiority to the snail above the oyster. Yet this distinction strongly and apparently obtains in nature; and we shall find the bivalved tribe of animals in every respect inferior to those we have been describing. Inferior in all their sensations; inferior in their powers of motion; but particularly inferior in their system of animal generation. The snail tribe, as we saw, are hermaphrodite, but require the assistance of each other for fecundation; all the bivalve tribe are hermaphrodite in like manner, but they require no assistance from each other towards impregnation; and a single muscle or oyster, if there were no other in the world, would quickly replenish the ocean. As the land snail, from its being best known, took the lead in the former class, so the fresh-

water muscle, for the same reason, may take the lead in this. The life and manners of such as belong to the sea will be best displayed in the comparison.

The Muscle, as is well known, whether belonging to fresh or salt water, consists of two equal shells, joined at the back by a strong muscular ligament, that answers all the purposes of a hinge. By the elastic contraction of these, the animal can open its shells at pleasure, about a quarter of an inch from each other. The fish is fixed to either shell by four tendons, by means of which it shuts them close, and keeps its body firm from being crushed by any shock against the walls of its own habitation. It is furnished, like all other animals of this kind, with vital organs, though these are situated in a very extraordinary manner. It has a mouth furnished with two fleshy lips; its intestine begins at the bottom of the mouth, passes through the brain, and makes a number of circumvolutions through the liver; on leaving this organ, it goes on straight into the heart, which it penetrates, and ends in the anus; near which the lungs are placed, and through which it breathes, like those of the snail kind; and in this manner its languid circulation is carried on.*

But the organs of generation are what most deserve to excite our curiosity. These consist in each muscle of two ovaries, which are the female part of its furniture, and of two seminal vessels, resembling what are found in the male. Each ovary and each seminal vessel has its own proper canal; by the ovary canal the eggs descend to the anus, and there also the seminal canals send their fluids to impregnate them. By this contrivance one single animal suffices for the double purposes of generation, and the eggs are excluded and impregnated by itself alone.

As the muscle is thus furnished with a kind of self-creating power, there are few places where it breeds that it is not found in great abundance. The ovaries usually empty themselves of their eggs in spring, and they are replenished in autumn. For this reason they are found empty in summer and full in winter. They produce in great numbers, as all bivalved shell-fish are found to do. The fecundity of the snail kind is trifling in comparison to the fertility of these. Indeed it may be asserted as a general rule in nature, that the more helpless and contemptible the animal, the more prolific it is always found. Thus all creatures that are incapable of resisting their destroyers, have nothing but their quick multiplication for the continuation of their existence.

The multitude of these animals in some places is very great, but from their defenceless state the number of their destroyers are in equal proportion. The crab, the cray-fish, and many other animals, are seen to devour them; but the trochus is their most formidable enemy. When their shells are found deserted, if we then observe closely, it is most probable we shall find that the

* M. Mery, Anat. des Moules d'Etang.

trochus has been at work in piercing them. There is scarcely one of them without a hole in it; and this probably was the avenue by which the enemy entered to destroy the inhabitant.

But notwithstanding the number of this creature's animated enemies, it seems still more fearful of the agitations of the element in which it resides; for if dashed against rocks, or thrown far on the beach, it is destroyed without a power of redress. In order to guard against these, which are to this animal the commonest and the most fatal accidents, although it has a power of slow motion, which I shall presently describe, yet it endeavours to become stationary, and to attach itself to any fixed object it happens to be near. For this purpose it is furnished with a very singular capacity of binding itself by a number of threads to whatever object it approaches; and these Reaumur supposed it spun artificially, as spiders their webs which they fasten against a wall. Of this, however, later philosophers have found very great reason to doubt. It is therefore supposed that these threads, which are usually called the beard of the muscle, are the natural growth of the animal's body, and by no means produced at pleasure. Indeed, the extreme length of this beard in some, which far exceeds the length of the body, seems impossible to be manufactured by the thrusting out and drawing in of the tongue, with the glutinous matter of which the French philosopher supposed those threads were formed. It is even found to increase with the growth of the animal; and as the muscle becomes larger and older, the beard becomes longer, and its filaments more strong.* Be this as it will, nothing is more certain than that the muscle is found attached by these threads to every fixed object; sometimes, indeed, for want of such an object, these animals are found united to each other; and though thrown into a lake separately, they are taken out in bunches of many together.

To have some fixed resting place, where the muscle can continue, and take in its accidental food, seems the state this animal chiefly desires. Its instrument of motion, by which it contrives to reach the object it wants to bind itself to, is that muscular substance resembling a tongue, which is found long in proportion to the size of the muscle. In some it is two inches long, in others not a third part of these dimensions. This the animal has a power of thrusting out of its shell, and with this it is capable of making a slight furrow in the sand at the bottom. By means of this furrow it can erect itself upon the edge of its shell; and thus continuing to make the furrow in proportion as it goes forward, it reaches out its tongue, that answers the purpose of an arm, and thus carries its shell edgeways, as in a groove, until it reaches the point intended. There, where it determines to take up its residence, it fixes the end of its beard, which are glutinous, to the rock or the object, whatever it be; and thus, like a ship at anchor, braves all the agitations of the water. Sometimes the animal is attached by a large number of threads,

* Mercier du Paty, sur les Bouchots à Moules. Tom. ii. de l'Académie de la Rochelle.

sometimes but by three or four, that seem scarce able to retain it. When the muscle is fixed in this manner, it lives upon the little earthy particles that the water transports to its shells, and perhaps the flesh of the most diminutive animals. However, it does not fail to grow considerably, and some of this kind have been found a foot long. I have seen the beards a foot and a half: and of this substance the natives of Palermo sometimes make gloves and stockings.

These shell-fish are found in lakes, rivers, and in the sea. Those of the lake often grow to a very large size; but they seem a solitary animal, and are found generally separate from each other. Those of rivers are not so large, but yet in greater abundance; but the sea muscle of all others is perhaps the most plenty. These are often bred artificially in salt water marshes that are overflowed by the tide; the fishermen throwing them in at the proper seasons, and there being undisturbed by the agitations of the sea, and not preyed upon by their powerful enemies at the bottom, they cast their eggs, which soon become perfect animals, and these are generally found in clusters of several dozens together. It requires a year for the peopling a muscle bed; so that if the number consists of forty thousand, a tenth part may annually be left for the peopling the bed anew. Muscles are taken from their beds from the month of July to October; and they are sold at a very moderate price.

From this animal the oyster differs very little, except in the thickness of its shell, and its greater imbecility. The oyster, like the muscle, is formed with organs of life and respiration, with intestines which are very voluminous, with a liver, lungs, and heart. Like the muscle, it is self-impregnated; and the shell, which the animal soon acquires, serves it for its future habitation. Like the muscle, it opens its shell to receive the influx of water; and like that animal, is strongly attached to its shells, both above and below.

But it differs in many particulars. In the first place, its shells are not equal, the one being cupped, and the other flat; upon the cupped shell it is always seen to rest, for if it lay upon the flat side it would then lose all its water. It differs also in the thickness of its shells, which are so strongly lined and defended, that no animal will attempt to pierce them. But though the oyster be secured from the attack of the small reptiles at the bottom, yet it often serves as an object to which they are attached. Pipe-worms and other little animals fix their habitation to the oyster's sides, and in this manner continue to live in security. Among the number of these is a little red worm, that is often found upon the shell; which some, from never seeing oysters copulate, erroneously supposed to be the male by which their spawn was impregnated.

The oyster differs also from the muscle in being utterly unable to change its situation. The muscle, as we have observed, is capable of erecting itself on an edge, and going forward with a slow laborious motion. The oyster is wholly passive, and endeavours by all its powers to rest fixed to one spot at the bottom. It is entirely

without that tongue which we saw answering the purposes of an arm in the other animal; but nevertheless is often attached very firmly to any object it happens to approach. Rocks, stones, pieces of timber, or sea-weeds, all seem proper to give it a fixture, and to secure it against the agitation of the waves. Nothing so common in the rivers of the tropical climates as to see oysters growing even amidst the branches of the forest. Many trees which grow along the banks of the stream often bend their branches into the water, and particularly the mangrove, which chiefly delights in a moist situation. To these the oysters hang in clusters like apples upon the most fertile tree; and in proportion as the weight of the fish sinks the plant into the water, where it still continues growing, the number of oysters increase, and hang upon the branches. Thus there is nothing that these shell-fish will not stick to; they are often even found to stick to each other. This is effected by means of a glue proper to themselves, which when it cements, the joining is as hard as the shell, and is as difficultly broken. The joining substance, however, is not always of glue; but the animal grows to the rocks, somewhat like the muscle, by threads; although these are only seen to take root in the shell, and not, as in the muscle, to spring from the body of the fish itself.

Oysters usually cast their spawn in May, which at first appear like drops of candle grease, and stick to any hard substance they fall upon. These are covered with a shell in two or three days; and in three years the animal is large enough to be brought to market. As they invariably remain in the places where they are laid, and as they grow without any other seeming food than the afflux of sea water, it is the custom at Colchester, and other parts of the kingdom, where the tide settles it marshes on land, to pick up great quantities of small oysters along the shore, which when first gathered seldom exceed the size of a sixpence. These are deposited in beds where the tide comes in, and in two or three years grow to a tolerable size. They are said to be better tasted for being thus sheltered from the agitation of the deep: and a mixture of fresh water entering into these repositories, is said to improve their flavour, and to increase their growth and fatness.

The oysters, however, which are prepared in this manner, are by no means so large as those found sticking to rocks at the bottom of the sea, usually called *rock-oysters*. These are sometimes found as broad as a plate, and are admired by some as excellent food. But what is the size of these compared to the oysters of the East Indies, some of whose shells I have seen two feet over! The oysters found along the coast of Coromandel are capable of furnishing a plentiful meal to eight or ten men; but it seems universally agreed that they are no way comparable to ours for delicacy of flavour.

Thus the muscle and the oyster appear to have but few distinctions, except in their shape and the power of motion in the former. Other bivalved shell-fish, such as the cockle, the scallop, and the razor-shell, have differences equally minute. The power of

changing place, which some of them effect in a manner quite peculiar to themselves, makes their greatest difference. The Scallop is particularly remarkable for its method of moving forward upon land, or swimming upon the surface of the water. When this animal finds itself deserted by the tide, it makes very remarkable efforts to regain the water, moving towards the sea in a most singular manner. It first gapes with its shell as widely as it can, the edges being often an inch asunder; then it shuts them with a jerk, and by this the whole animal rises five or six inches from the ground. It thus tumbles any how forward, and then renews the operation until it has attained its journey's end. When in the water it is capable of supporting itself upon the surface; and by there opening and shutting its shells, it tumbles over and over, and makes its way with some celerity.

The Pivot, or Razor-shell, has a very different kind of motion. As the former moves laboriously and slowly forward, so the razor-shell has only a power of sinking point downward. The shells of this animal resemble nothing so much as the haft of a razor; and by this form it is better enabled to dive into the soft sand at the bottom. All the motions of this little animal are confined to sinking or rising a foot downwards or upwards in the sand, for it never leaves the spot where first it was planted. From time to time it is seen to rise about half-way out of its hole; but if any way disturbed, it sinks perpendicularly down again. Just over the place where the razor buries itself, there is a small hole like a chimney, through which the animal breathes, or imbibes the sea water. Upon the desertion of the tide, these holes are easily distinguished by the fishermen who seek for it; and their method of enticing the razor up from the depth or its retreat is by sprinkling a little sea-salt upon the hole. This melting, no sooner reaches the razor below, than it rises instantly straight upwards, and shows about half its length above the surface. This appearance, however, is instantaneous; and if the fisher does not seize the opportunity, the razor buries itself with great ease to its former depth. There it continues secure; no salt can allure it a second time; but it remains unmolested, unless the fisher will be at the trouble of digging it out, sometimes two feet below the surface.

Such are the minute differences between bivalved shell-fish; but in the great outlines of their nature they exactly resemble each other. It is particularly in this class of shell-fish that pearls are found in great abundance; and it is in the internal parts of those shells that are of a shining silvery colour that these gems are usually generated; but the pearl is also found to breed as well in the muscle or the scallop as in the oyster. In fact, it is found in all bivalved shells, the insides of which resemble that well-known substance called mother-of-pearl.

Whether pearls be a disease or an accident in the animal, is scarcely worth inquiry. The common opinion is, that they are a kind of calculous concretion in the body of the animal, some-

what resembling a stone in the bladder, and are consequently to be considered as a disorder. It is said, in confirmation of this opinion, that those coasts upon which pearls are fished are very unhealthy; and therefore most probably oysters share the general influence of the climate:—It is also added, that those oysters in which pearls are found are always ill-tasted, which is a sign of their being unsound; and lastly, it is asserted that the pearl grows sometimes so big as to keep the shells of the animal from shutting, and that thus it dies by being exposed. It is easy to see the weakness of these assertions, which seem neither true nor amusing. To answer them in their own way, if a stone in the bladder be a disorder, a stone in the stomach of an ostrich is a benefit, and so it may be in the shell of an oyster. If the shores where the pearls are fished be unwholesome to man, that, instead of being disadvantageous, is so much the more lucky for the oyster. If the pearl oysters are the worst tasted, so are kites and ravens among birds; and yet we know that they are healthy and long-lived animals. If the oyster had ever its shell kept asunder by the pearl within it, that would be a disease indeed; but this in reality never happens; for the oyster that breeds a large pearl always breeds a large shell, and the shell itself indents to receive its impression. The pearl, upon the whole, seems bred from no disorder in the animal, but accidentally produced by the same matter that goes to form the shell. This substance, which is soft at first, quickly hardens; and thus, by successive coats, layer over layer, the pearl acquires its dimensions. If cut through, it will be found to consist of several coats, like an onion; and sometimes a small speck is seen in the middle, upon which the coats were originally formed.

All oysters, and most shell-fish, are found to contain pearls; but that which particularly obtains the name of the pearl oyster, has a large strong whitish shell, wrinkled and rough without, and within smooth and of a silver colour. From these the mother-of-pearl is taken, which is nothing more than the internal coats of the shell, resembling the pearl in colour and consistence. This is taken out and shaped into that variety of utensils which are found so beautiful; but the pearl itself is chiefly prized, being found but in few oysters, and generally adhering, sometimes making a print in the body of the shell, sometimes at large within the substance of the fish.

There are a great number of pearl fisheries in America and Asia; but as pearls bear a worse price than formerly, those of America are in a great measure discontinued. The most famous of all the Asiatic fisheries is in the Persian Gulf, near the Isle of Bahren. There is another between the coast of Madura and the Island of Ceylon; and there was a third on the coasts of Japan: but as these noble islanders have a contempt for jewels, and an abhorrence for such Europeans as come in pursuit of them, that fishery, which is thought to be the most valuable of all others, is

discontinued. The diving business is now carried on only in those countries where the wretchedness of one part of mankind goes to support the magnificence of the other.

The chief fishery, as we said, is carried on in the Persian Gulf, and the most valuable pearls are brought from thence. The value of these jewels increases, not only in proportion to their size, but also their figure and colour; for some pearls are white, others are yellowish, others of a lead colour; and some affirm that they have been found as black as jet. What it is that gives these different tinctures to pearls is not known; Taverner ascribes it to their lying two or three weeks upon shore after the oyster is taken; Reaumur thinks it proceeds from the colour of that part of the fish's body upon which the pearl lies. It is most probable that this colour proceeds, like the spots frequently found on the internal surface of the shell itself, from some accident while the pearl is growing.

The best coloured pearls and the roundest are brought from the East; those of America are neither so white nor so exactly oval. All pearls, however, in time become yellow; they may be considered as an animal substance converted into a stony hardness, and, like ivory, taking a tincture from the air. They have been even found to decay when in damp or vaulted places, and to moulder into a substance scarce harder than chalk. When the daughters of Stilicon, who were both betrothed, one after the other, to the emperor Honorious, were buried, much of their finery was also deposited with them in the same tomb. In this manner they remained buried for above eleven hundred years, till the foundations of the church of St. Peter were laying. Their tomb was then discovered, and all their finery was found in tolerable preservation except their pearls, which were converted by time and damps into a chalky powder.

The wretched people that are destined to fish for pearls, are either Negroes or some of the poorest of the natives of Persia. The inhabitants of this country are divided into tyrants and slaves. The divers are not only subject to the dangers of the deep, to tempests, to suffocation at the bottom, to being devoured by sharks, but from their profession universally labour under a spitting of blood, occasioned by the pressure of air upon their lungs in going down to the bottom. The most robust and healthy young men are chosen for this employment, but they seldom survive it above five or six years. Their fibres become rigid, their eye-balls turn red, and they usually die consumptive.

It is amazing how very long they are seen to continue at the bottom. Some, as we are assured, have been known to continue three quarters of an hour under water without breathing; and to one unused to diving, ten minutes would suffocate the strongest. Whether from some effort the blood bursts the old passage which it had in the fœtus, and circulates without going through the lungs, it is not easy to tell: but certain it is, that some bodies have been

dissected with this canal of communication open, and these extraordinary divers may be internally formed in that manner.

Be this as it may, no way of life seems so laborious, so dangerous, or so painful. They fish for pearls, or rather the oysters that contain them, in boats twenty-eight feet long; and of these there are sometimes three or four hundred at a time, with each seven or eight stones, which serve for anchors. There are from five to eight divers belonging to each, that dive one after another. They are quite naked, except that they have a net hanging down from the neck to put the oysters in, and gloves on their hands to defend them while they pick the oysters from the holes in the rocks; for in this manner alone can they be gathered. Every diver is sunk by means of a stone, weighing fifty pounds, tied to the rope by which he descends. He places his foot in a kind of stirrup, and laying hold of the rope with his right hand, he stops his nose to keep in his breath, as upon going down he takes in a very long inspiration. They are no sooner come to the bottom, but they give the signal to those who are in the boat to draw up the stone; which done they go to work, filling their net as fast as they can; and then giving another signal, the boats above pull up the net loaded with oysters, and shortly after the diver himself, to take a new inspiration. They dive to the depth of fifteen fathoms, and seldom go deeper. They generally go every morning by break of day to this fatiguing employment, taking the land-wind to waft them out to sea, and returning with the sea-breeze at night. The owners of the boats usually hire the divers, and the rest of the boat's crew, as we do our labourers at so much a day. All the oysters are brought on shore, where they are laid in a great heap till the pearl fishery is over, which continues during the months of November and December. When opportunity serves, they then examine every oyster, and it is accidental whether the capture turns out advantageous. Indeed no human being can wish well to a commerce, which thus chains such a number of fellow-creatures to the bottom, to pluck up a glittering, mouldering pebble.

CHAPTER VII.

OF MULTIVALVE SHELL FISH.

MULTIVALVE shell-fish, may be considered as animals shut up in round boxes. To view their habitations externally, one would be little apt to consider them as the retreats of living creatures; and still less to suppose that some of them carry their boxes with a tolerable share of swiftness, so as to escape their pursuers. Of these there are principally two kinds; such as move, and such as are stationary: the first are usually known in our cabinets by the

name of sea-eggs; the others are as often admired, from the cavities which they scoop out for their habitation in the hardest marble. The first are called by naturalists, Echini, or Urchins; the latter are called Pholades, or File-fish. Of both there are several sorts; but, by describing these two, we shall have a competent idea of all the rest.

On a slight view the see urchin may be compared to the husk of a chesnut; being like it round, and with a number of bony prickles standing out on every side. To exhibit this extraordinary animal in every light—If we could conceive a turnip stuck full of pins on every side, and running upon these pins with some degree of swiftness, we should have some idea of this extraordinary creature. The mouth is placed downwards; the vent is above; the shell is a hollow vase, resembling a scooped apple; and this filled with a soft muscular substance, through which the intestines wind from the bottom to the top. The mouth, which is placed undermost, is large and red, furnished with five sharp teeth, which are easily discerned. The jaws are strengthened by five small bones, in the centre of which is a small fleshy tongue; and from this the intestines make a winding of five spires round the internal sides of the shell, ending at top, where the excrements are excluded. But what makes the most extraordinary part of this animal's conformation, are its horns and its spines, that point from every part of the body, like the horns of a snail, and that serve at once as legs to move upon, as arms to feel with, and as instruments of capture and defence. Between these horns it has also spines that are not endued with such a share of motion. The spines and the horns issue from every part of the body; the spines being hard and prickly, the horns being soft, longer than the spines, and never seen except in the water. They are put forward and withdrawn like the horns of a snail, and are hid at the bases of the spines, serving, as was said before, for procuring food and motion. All this apparatus, however, is only seen when the animal is hunting its prey at the bottom of the water; for, a few minutes after it is taken, all the horns are withdrawn into the body, and most of the spines drop off.

It is generally said of insects, that those which have the greatest number of legs, always move the slowest: but this animal seems to be an exception to the rule; for though furnished with two thousand spines, and twelve hundred horns, all serving for legs, and from their number seeming to impede each other's motion, yet it runs with some share of swiftness at the bottom, and it is sometimes no easy matter to overtake it. It is often taken upon the ebb, by following it in shallow water, either in an ozier basket, or simply with the hand. Both the spines and the horns assist its motion; and the animal is usually seen running with the mouth downward.

Some kinds of this animal are as good eating as the lobster; and its eggs, which are of a deep red, are considered as a very great delicacy. But of others the taste is but indifferent; and in all

soft pudding, with no instrument that seems in the least fitted for boring into stones, or even penetrating the softest substances. It is furnished with two teeth indeed; but these are placed in such a situation as to be incapable of touching the hollow surface of its stony dwelling: it has also two covers to its shell, that open and shut at either end; but these are totally unserviceable to it as a miner. The instrument with which it performs all its operations, and buries itself in the hardest rocks, is only a broad fleshy substance, somewhat resembling a tongue, that is seen issuing from the bottom of its shell. With this soft yielding instrument, it perforates the most solid marbles; and having, while yet little and young, made its way by a very narrow entrance into the substance of the stone, it then begins to grow bigger, and thus to enlarge its apartment.

The seeming unfitness, however, of this animal for penetrating into rocks, and there forming an habitation, has induced many philosophers to suppose that they entered the rock while it was yet in a soft state, and from the petrifying quality of the water, that the whole rock afterwards hardened round them by degrees. Thus any penetrating quality, it was thought, was unjustly ascribed to them, as they only bored into a soft substance that was hardened by time. This opinion, however, has been confuted, in a very satisfactory manner, by Dr. Bohadsch, who observed, that many of the pillars of the temple of Serapis at Puteoli, were penetrated by these animals. From thence he very justly concludes, that the pholades must have pierced into them since they were erected, for no workmen would have laboured a pillar into form, if it had been honey-combed by worms in the quarry. In short, there can be no doubt but that the pillars were perfectly sound when erected; and that the polades have attacked them during the time in which they continued buried under water, by means of the earthquake that swallowed up the city.*

From hence it appears, that in all nature there is not a greater instance of perseverance and patience than what this animal is seen to exhibit. Furnished with the bluntest and softest auger, by slow successive applications it effects what other animals are incapable of performing by force, penetrating the hardest bodies only with its tongue. When, while yet naked and very small, it has effected an entrance, and has buried its body in the stone, it there continues for life at its ease; the sea water that enters at the little aperture supplying it with luxurious plenty. When the animal has taken too great a quantity of water, it is seen to spurt it out of its hole with some violence. Upon this seemingly thin diet it quickly grows larger, and soon finds itself under the necessity of enlarging its habitation and its shell. The motion of the pholas is slow beyond conception; its progress keeps pace with the growth of its body; and in proportion as it becomes larger, it makes its

* Bohadsch de Animalibus Marinis, p. 153.

way farther into the rock. When it has got a certain way in, it then turns from its former direction, and hollows downward; till, at last, when its habitation is completed, the whole apartment resembles the bowl of a tobacco-pipe, the hole in the shank being that by which the animal entered.

Thus immured, the pholas lives in darkness, indolence, and plenty; it never removes from the narrow mansion into which it has penetrated, and seems perfectly content with being enclosed in its own sepulchre. The influx of the sea water, that enters by its little gallery, satisfies all its wants; and, without any other food, it is found to grow from seven to eight inches long, and thick in proportion.

But they are not supplied only with their rocky habitation; they have also a shell to protect them: this shell grows upon them in the body of the rock, and seems a very unnecessary addition to the defence which they have procured themselves by art. These shells take different forms, and are often composed of a different number of valves; sometimes six, sometimes but three; sometimes the shell resembles a tube with holes at either end, one for the mouth, and the other for voiding the excrements.

Yet the pholas, thus shut up, is not so solitary an animal as it would at first appear; for though it is immured in its hole, without egress; though it is impossible for the animal, grown to a great size, to get out by the way it made in, yet many of this kind often meet in the heart of the rock, and, like miners in a siege, who sometimes cross each other's galleries, they frequently break in upon each other's retreats. Whether their thus meeting be the work of accident, or of choice, few can take upon them to determine; certain it is, they are most commonly found in numbers in the same rock, and sometimes above twenty are discovered within a few inches of each other.

As to the rest, this animal is found in greatest numbers at Ancona, in Italy; it is found along the shores of Normandy and Poitou in France; it is found also upon some of the coasts of Scotland; and in general is considered as a very great delicacy at the tables of the luxurious.

FROG.

COBRA DE CAPELLA.

OF FROGS, LIZARDS, AND SERPENTS.

CHAPTER I.

OF FROGS AND TOADS IN GENERAL.

If we emerge from the deep, the first and most obvious class of amphibious animals that occur upon land are frogs and toads. These, wherever they reside, seem equally adapted for living upon land and in the water, having their hearts formed in such a manner as to dispense with the assistance of the lungs in carrying on the circulation. The frog and the toad therefore can live several days under water, without any danger of suffocation: they want but little air at the bottom, and what is wanting is supplied by lungs, like bladders, which are generally distended with wind, and answer all the purposes of a reservoir from whence to breathe.

To describe the form of animals so well known would be superfluous; to mark those differences that distinguish them from each other, may be necessary. The frog moves by leaping, the toad crawls along the ground. The frog is in general less than the toad, its colour is brighter, and with a more polished surface; the toad is brown, rough, and dusky. The frog is light and active, and its belly comparatively small; the toad is slow, swoln, and incapable of escaping. The frog when taken contracts itself so as to have a lump on its back; the toad's back is straight and even. Their internal parts are nearly the same, except that the lungs of the toad are more compact than those of the frog: they have air-bladders, and of consequence the animal is less fitted for living under water. Such are the differences with respect to figure and conformation; their habitudes and manners exhibit a greater variety, and require a separate description.

CHAPTER II.

OF THE FROG, AND ITS VARIETIES.

The external figure of the Frog is too well known to need a description. Its power of taking large leaps is remarkably great, compared to the bulk of its body. It is the best swimmer of all four-footed animals; and nature hath finely adapted its parts for those ends, the arms being light and active, the legs and thighs long, and furnished with very strong muscles.

places except the Mediterranean, they are little sought for, except as objects of curiosity.

Very different in motion, though not much different in shape, from these, are the Acorn Shell-fish, the Thumb-footed Shell-fish, and the Imaginary Barnacle. These are fixed to one spot, and appear to vegetate from a stalk. Indeed, to an inattentive spectator, each actually seems to be a kind of fungus that grows in the deep, destitute of animal life as well as motion. But the inquirer will soon change his opinion, when he comes to observe this mushroom-like figure more minutely. He will then see that the animal residing within the shell has not only life, but some degree of voraciousness; that it has a cover by which it opens and shuts its shell at pleasure; that it has twelve long crooked arms, furnished with hair, which it thrusts forth for its prey, and eight smaller, which are generally kept in the shell. These are seen adhering to every substance that is to be met with in the ocean; rocks, roots of trees, ships' bottoms, whales, lobsters, and even crabs; like bunches of grapes, clung to each other. It is amusing enough to behold their operations.* They for some time remain motionless within their shell; but when the sea is calm, they are seen opening the lid, and peeping about them. They then thrust out their long neck, look round them for some time, and then abruptly retreat back into their box, shut their lid, and lurk in darkness and security. Some people eat them; but they are in no great repute at the tabes of the luxurious, where their deformed figure would be no objection to their being introduced.

Of all the animals of the shelly tribe, the Pholades are the most wonderful.† From their great powers of penetration, compared with their apparent imbecility, they justly excite the astonishment of the curious observer. These animals are found in different places; sometimes concealed in lumps of marly earth; and sometimes lodged, shell and all, in the body of the hardest marble. In their proper shell they assume different figures; but, in general, they somewhat resemble a muscle, except that their shell is found actually composed of five or more pieces, the smaller valves serving to close up the opening left by the irregular meeting of the two principal shells. But their penetration into rocks, and their residence there, makes up the most wonderful part of their history.

This animal, when divested of its shell, resembles a roundish

* Anderson's History of Greenland.

[† The Pholas is remarkable for its luminous quality. This was noticed by Pliny, who observes that it shines in the mouth of the person who eats it, and if it touch his hand or clothes, it makes them luminous. M. Reaumur says, that whereas other fishes give light when they tend to putrescence, this is more luminous in proportion to its being fresh; that when they are dried, their light will revive if they be moistened either with fresh or salt water, but that brandy immediately extinguishes it. He endeavoured to make this light permanent, but none of his schemes succeeded. A single pholas, when put into a vessel containing seven ounces of milk, made it so luminous, that the faces of persons might be distinguished by it, and it looked as if it was transparent.]

If we examine this animal internally, we shall find that it has a very little brain for its size, a very wide swallow, a stomach seemingly small, but capable of great distension. The heart in the frog, as in all other animals that are truly amphibious, has but one ventricle; so that the blood can circulate without the assistance of the lungs while it keeps under water. The lungs resemble a number of small bladders joined together, like the cells of a honey-comb; they are comected to the back by muscles, and can be distended or exhausted at the animal's pleasure. The male has two testiculi lying near the kidneys, and the female has two ovaries lying near the same place; but neither male nor female have any of the external instruments of generation, the anus serving for that purpose in both. Such are the most striking peculiarities in the anatomy of the frog; and in these it agrees with the toad, the lizard, and the serpent. They are all formed internally pretty much in the same manner, with spongy lungs, a simple heart, and are destitute of the external instruments that serve to continue the kind.

Of all those who have given histories of the frog, M. Ræsel of Nuremberg seems the most accurate and entertaining. His plates of this animal are well known; his assiduity and skilfulness in observing its manners are still more deserving our esteem. Instead, therefore, of following any other, I will take him for my guide; and though it be out of my power to amuse the reader with his beautiful designs, yet there will be some merit in transcribing his history.

The Common Brown Frog begins to couple early in the season, and as soon as the ice is thawed from the stagnating waters. In some places the cold protracts their genial appetite till April, but it generally begins about the middle of March. The male is usually of a greyish-brown colour; the female is more inclining to yellow, speckled with brown. When they couple, the colours of both are nearly alike on the back; but as they change their skins almost every eighth day, the old one falling off in the form of mucus, the male grows yellower, and the female more brown. In the males, the arms and legs are much stronger than in the females; and at the time of coupling they have upon their thumbs a kind of fleshy excrescence, which they fix firmly to the breast of the female. This Linnæus supposed to be the male instrument of generation; but by closer inspection it is found only of service in holding the female in a more strict embrace. It may be cut off, and the impregnation continue unimpaired; it is sometimes found in the opposite sex, and some of the males are found entirely without it; however, when it is cut off, the male cannot hold the female so strongly as before.

The sexes couple only once a-year, and then continue united sometimes for four days together. At this time they both have their bellies greatly swoln; that of the female being filled with eggs, the male having the skin of the whole body distended with

a limpid water, which is ejected in impregnation. As soon as the male has leaped upon the female, he throws his fore-legs round her breast, and closes them so firmly that it is impossible with the naked hands to loose them. The male clasps his fingers between each other in the same manner as people when they are praying; the thumbs press with their thickest sides against the breast of the female; and though she should struggle ever so much, nothing can induce him to let go his hold. The grasp seems involuntary and convulsive; they cannot be easily torn asunder; and they swim, creep, and live united for some days successively, till the female has shed her spawn, which at length she does almost in an instant. But how the impregnation is performed without any apparent instruments of generation, has long been an object of inquiry, and still continues in great obscurity. To investigate the difficulty as carefully as possible, our German philosopher continued to examine their mutual congress for three years together, and availed himself of all the lights that the knife or analogy could furnish.

After having chosen twelve couple of frogs that were thus joined to each other, and having placed each couple in a glass vessel with water, he scarcely let them out of his sight day or night, and even sate up two nights together to examine their operations. The first day he observed nothing that deserved remark, but the second they began to be agitated more than before; the males made a noise somewhat resembling the grunting of a hog, the females only kept sinking and rising in the water.

The male of the first couple ejected the humidity with which his body was swoln, by which the water in the glass was made muddy, and he soon after quitted the female. Our philosopher continued for twelve hours to observe whether the female would cast her spawn; but finding her tardy, he dissected both her and the male: in the latter, the spermatic vessels were quite empty, as might naturally have been supposed; but for the female, her spawn still remained in her body. Upon its being extracted, and put into water, it perished without producing any animal whatever. From hence he justly concluded, that it required that the eggs should be ejected from the body of the female before they could be at all prolific. In another pair the male quitted the female, who did not eject her spawn till sixteen days after; and these like the former, came to nothing. But it was very different with some of the rest. The females ejected their spawn, while the male still remained in his station, and impregnated the masses at different intervals as they fell from her; and these all brought forth animals in the usual course of generation. From these observations it was easy to infer, that the female was impregnated neither by the mouth, as some philosophers imagined, nor by the excrescence at the thumbs, as was the opinion of Linnæus, but by the inspersion of the male seminal fluid upon the eggs as they proceeded from the body.

A single female produces from six to eleven hundred eggs at a time; and in general she throws them all out together by a single effort, though sometimes she is an hour in performing this task. While she is thus bringing forth, it may be observed, that the male acts the part of a midwife, and promotes the expulsion of the eggs by working with his thumbs and compressing the female's body more closely. The eggs, which were compressed in the womb, upon being emitted, expand themselves into a round form, and drop to the bottom of the water; while the male swims off, and strikes with his arms as usual, though they had continued so long in a state of violent contraction.

The egg, or little black globe, which produces a tadpole, is surrounded with two different kinds of liquor. That which immediately surrounds the globe is clear and transparent, and contained in its proper membrane; that which surrounds the whole is muddy and mucous. The transparent liquor serves for the nourishment of the tadpole from time to time, and answers the same purpose that the white of the egg does to birds. The tadpoles, when this membrane is broken, are found to adhere with their mouth to part of it; and when they get free they immediately sink to the bottom of the water, never being able to get to the top after, while they continue in their tadpole form.

But to return:—When the spawn is emitted and impregnated by the male, it drops, as was said, to the bottom, and there the white quickly and sensibly increases. The eggs, which during the four first hours suffer no perceptible change, begin then to enlarge and grow lighter, by which means they mount to the surface of the water. At the end of eight hours the white in which they swim grows thicker, the eggs lose their blackness, and, as they increase in size, somewhat of their spherical form.

The twenty-first day the egg is seen to open a little on one side, and the beginning of a tail to peep out, which becomes more and more distinct every day. The thirty-ninth day the little animal begins to have motion; it moves at intervals its tail; and it is perceived that the liquor in which it is circumfused serves for its nourishment. In two days more, some of these little creatures fall to the bottom, while others remain swimming in the fluid around them, while their vivacity and motion is seen to increase. Those which fall to the bottom remain there the whole day; but having lengthened themselves a little, for hitherto they are doubled up, they mount at intervals to the mucus which they had quitted, and are seen to feed upon it with great vivacity. The next day they acquire their tadpole form. In three days more they are perceived to have two little fringes, that serve as fins beneath the head; and these in four days after assume a more perfect form. It is then also that they are seen to feed very greedily upon the pond-weed with which they are to be supplied; and, leaving their former food, on this they continue to subsist till they arrive at maturity. When they come to be ninety-two days old, two small feet are seen

beginning to bourgeon near the tail, and the head appears to be separate from the body. The next day the legs are considerably enlarged; four days after, they refuse all vegetable food; their mouth appears furnished with teeth; and their hinder legs are completely formed. In two days more the arms are completely produced; and now the frog is every way perfect, except that it still continues to carry the tail. In this odd situation the animal, resembling at once both a frog and a lizard, is seen frequently rising to the surface, not to take food but to breathe. In this state it continues for about six or eight hours; and then the tail dropping off by degrees, the animal appears in its most perfect form.

Thus the frog, in less than a day, having changed its figure, is seen to change its appetites also. So extraordinary is this transformation, that the food it fed upon so greedily but a few days before, is now utterly rejected; it would even starve if supplied with no other. As soon as the animal acquires its perfect state, from having fed upon vegetables it becomes carnivorous, and lives entirely upon worms and insects. But as the water cannot supply these, it is obliged to quit its native element, and seek for food upon land, where it lives by hunting worms and taking insects by surprise. At first, being feeble, and unable to bear the warmth of the sun, it hides among bushes and under stones; but when a shower comes to refresh the earth, then the whole multitude are seen to quit their retreats, in order to enjoy the grateful humidity. Upon many occasions the ground is seen perfectly blackened with their numbers; some hunting for prey, and some seeking secure lurking-places. From the myriads that offer on such occasions, some have been induced to think that these animals were generated in the clouds, and thus showered down upon the earth. But had they, like Derham, traced them to the next pool, they would have found out a better solution for the difficulty.

The frog lives for the most part out of the water; but when the cold nights begin to set in, it returns to its native element, always choosing stagnant waters, where it can lie without danger concealed at the bottom. In this manner it continues torpid, or with but very little motion, all the winter: like the rest of the dormant race, it requires no food; and the circulation is slowly carried on without any assistance from the air.

It is at the approach of spring that all these animals are roused from a state of slumber to a state of enjoyment. A short time after they rise from the bottom they begin to pair, while those that are as yet too young come upon land before the rest. For this reason, while the old ones continue concealed in the beginning of spring, the small ones are more frequently seen; the former remaining in the lake to propagate, while the latter are not yet arrived at a state of maturity.

The difference of sexes, which was mentioned above, is not perceivable in these animals until they have arrived at their fourth

year; nor do they begin to propagate till they have completed that period. By comparing their slow growth with their other habitudes, it would appear that they live about twelve years; but having so many enemies, both by land and water, it is probable that few of them arrive at the end of their term.

Frogs live upon insects of all kinds; but they never eat any unless they have motion. They continue fixed and immoveable till their prey appears; and just when it comes sufficiently near, they jump forward with great agility, dart out their tongues, and seize it with certainty. The tongue in this animal, as in the toad, lizard, and serpent kinds, is extremely long, and formed in such a manner that it swallows the point down its throat; so that a length of tongue is thus drawn out, like a sword from its scabbard, to assail its prey. This tongue is furnished with a glutinous substance, and whatever insect it touches, infallibly adheres, and is thus held fast till it is drawn into the mouth.

As the frog is thus supplied with the power of catching its prey, it is also very vivacious, and able to bear hunger for a very long time. I have known one of them continue a month in summer without any other food than the turf on which it was placed in a glass vessel. We are told of a German surgeon that kept one eight years in a glass vessel covered with a net. Its food was at all times but sparing; in summer he gave it fresh grass, which it is said to have fed upon, and in the winter, hay a little moistened; he likewise now and then put flies into the glass, which it would follow with an open mouth, and was very expert in catching them. In winter, when the flies were difficult to be found, it usually fell away, and grew very lean; but in the summer, when they were plenty, it soon grew fat again. It was kept in a warm room, and was always lively and ready to take its prey; however, in the eighth winter, when there were no flies to be found, it fell away and died. It is not certain how long it might have lived had it been supplied with proper nourishment; but we are certain, that a very little food is capable of sufficing its necessities.

Nor is the frog less tenacious of life. It will live and jump about several hours after its head has been cut off; it will continue active, though all its bowels are taken out; and it can live some days though entirely stripped of its skin. This cruel trick, which is chiefly practised among school-boys, of skinning frogs, an operation which is done in an instant, seems for some hours no way to abate their vigour. I am assured that some of them get a new skin, and recover after this painful experiment.

The croaking of frogs is well known; and from thence, in some countries, they are distinguished by the ludicrous title of *Dutch Nightingales*. Indeed, the aquatic frogs of Holland are loud beyond what one would imagine. We could hardly conceive that an animal not bigger than one's fist, should be able to send forth a note that is heard at three miles distance: yet such is actually the

case.* The large water frogs have a note as loud as the bellowing of a bull; and, for this purpose, puff up the cheeks to a surprising magnitude. Of all frogs, however, the male only croaks; the female is silent, and the voice in the other seems to be the call to courtship. It is certain, that at those times when they couple, the loudness of their croaking is in some places very troublesome; for then the whole lake seems vocal, and a thousand dissonant notes perfectly stun the neighbourhood. At other times also, before wet weather, their voices are in full exertion; they are then heard, with unceasing assiduity, sending forth their call, and welcoming the approaches of their favourite moisture. No weather-glass was ever so true as a frog in foretelling an approaching change; and, in fact, the German surgeon mentioned above, kept his frog for that purpose. It was always heard to croak at the approach of wet weather, but was as mute as a fish, when it threatened a continuance of fair. This may probably serve to explain an opinion which some entertain, that there is a month in the year called *Paddock Moon*, in which the frogs never croak; the whole seems to be no more than that, in the hot season, when the moisture is dried away, and consequently when these animals neither enjoy the quantity of health or food that at other times they are supplied with, they show by their silence, how much they are displeased with the weather. All very dry weather is hurtful to their health, and prevents them from getting their prey. They subsist chiefly upon worms and snails; and as drought prevents these from appearing, the frog is thus stinted in its provisions, and also wants that grateful humidity which moistens its skin, and renders it alert and active.

As frogs adhere closely to the backs of their own species, so it has been found, by repeated experience, they will also adhere to the backs of fishes. Few that have ponds but know, that these animals will stick to the backs of carp, and fix their fingers in the corner of each eye. In this manner they are often caught together; the carp blinded and wasted away. Whether this proceeds from the desires of the frog, disappointed of its proper mate, or whether it be a natural enmity between frogs and fishes, I will not take upon me to say. A story told us by Walton, might be apt to incline us to the latter opinion.

"As Dubravius, a bishop of Bohemia, was walking with a friend by a large pond in that country, they saw a frog, when a pike lay very sleepily and quiet by the shore side, leap upon his head, and the frog having expressed malice or anger by his swoln cheeks and staring eyes, did stretch out his legs, and embraced the pike's head, and presently reach them to his eyes, tearing with them and his teeth those tender parts; the pike, irritated with anguish, moves up and down the water, and rubs himself against weeds, and whatever he thought might quit him of his enemy; but all in vain, for the frog did continue to ride triumphantly, and to bite and

* Ræsel, ibid.

torment the pike till his strength failed, and then the frog sunk with the pike to the bottom of the water: then presently the frog appeared again at the top and croaked, and seemed to rejoice like a conqueror; after which he presently retired to his secret hole. The bishop that had beheld the battle called his fisherman to fetch his nets, and by all means to get the pike, that they might declare what had happened. The pike was drawn forth, and both his eyes eaten out; at which they began to wonder, the fisherman wished them to forbear, and assued them he was certain that pikes were often so served."

CHAPTER III.

OF THE TOAD, AND ITS VARIETIES.

If we regard the figure of the Toad, there seems nothing in it that should disgust more than that of the frog. Its forms and proportions are nearly the same; and it chiefly differs in colour, which is blacker; and its slow and heavy motion, which exhibits nothing of the agility of the frog: yet such is the force of habit, begun in early prejudice, that those who consider the one as a harmless, playful animal, turn from the other with horror and disgust. The frog is considered as an ussful assistant in ridding our grounds of vermin; the toad as a secret enemy, that only wants an opportunity to infect us with its venom.

The imagination, in this manner biassed by its terrors, paints out the toad in the most hideous colouring, and clothes it in more than natural deformity. Its body is broad; its back flat; covered with a dusky, pimpled hide; the belly is large and swagging; the pace laboured and crawling; its retreat gloomy and filthy; and its whole appearance calculated to excite disgust and horror: yet upon my first seeing a toad, none of all these deformities in the least affected me with sensations of loathing: born, as I was, in a country where there are no toads, I had prepared my imagination for some dreadful object; but there seemed nothing to me more alarming in the sight than that of a common frog; and indeed, for some time, I mistook and handled the one for the other. When first informed of my mistake, I very well remember my sensations: I wondered how I had escaped with safety, after handling and dissecting a toad, which I had mistaken for a frog. I then began to lay in a fund of horror against the whole tribe, which, though convinced they are harmless, I shall never get rid of. My first imginations were too strong, not only for my reason, but for the conviction of my senses.

As the toad bears a general resemblance of figure to the frog, so also it resembles that animal in its nature and appetites. Like the frog, the toad is amphibious; like that animal, it lives upon worms

and insects, which it seizes by darting out its length of tongue; and in the same manner also it crawls about in moist weather. The male and female couple as in all the frog kind, their time of propagation being very early in the spring. Sometimes the females are seen upon land, oppressed by the males, but more frequently they are coupled in the water. They continue together some hours, and adhere so fast as to tear the very skin from the parts they stick to. In all this they entirely resemble the frog; but the assistance which the male lends the female in bringing forth, is a pecularity in this species that must not be passed over in silence. "In the evening of a summer's-day, a French gentleman being in the king's gardens at Paris, perceived two toads coupled together, and he stopped to examine them. Two facts equally new surprised him: the first was the extreme difficulty the female had in laying her eggs; the second was the assistance lent her by the male for this purpose. The eggs of the female lie in her body like beads on a string; and after the first, by great effort, was excluded, the male caught it with his hinder paws, and kept working it till he had thus extracted the whole chain. In this manner the animal performed, in some measure, the functions of a midwife; impregnating, at the same time, every egg as it issued from the body."

It is probable, however, that this difficulty in bringing forth obtains only upon land; and that the toad which produces its spawn in the water, performs it with as much ease as a frog. They propagate in England, exactly in the manner of frogs; and the female, instead of retiring to dry holes, goes to the bottom of ponds, and there lies torpid all the winter, preparing to propagate in the beginning of spring. On these occasions, the number of males is found greatly to surpass that of the other sex, there being above thirty to one; and twelve or fourteen are often seen clinging to the same female.

When, like the frog, they have undergone all the variations of their tadpole state, they forsake the water; and are often seen in a moist summer's evening, crawling up, by myriads, from fenny places into drier situations. There, having found out a retreat, or having dug themselves one with their mouth and hands, they lead a patient solitary life, seldom venturing out, except when the moisture of a summer's evening invites them abroad. At that time the grass is filled with snails, and the pathways covered with worms, which make their principal food. Insects also of every kind they are fond of; and we have the authority of Linnæus for it, that they sometimes continue immoveable, with their mouth open, at the bottom of shrubs, where the butterflies, in some measure fascinated, are seen to fly down their throats.*

In a letter from Mr. Arscott there are some curious particulars relating to this animal, which throw great light upon its history. "Concerning the toad," says he, "that lived so many years with

* Amœnit. vol. vi. p. 201.

us, and was so great a favourite, the greatest curiosity was its becoming so remarkably tame: it had frequented some steps before our hall-door some years before my acquaintance commenced with it, and had been admired by my father for its size, (being the largest I ever met with), who constantly paid it a visit every evening. I knew it myself above thirty years; and by constantly feeding it, brought it to be so tame, that it always came to the candle and looked up, as if expecting to be taken up and brought upon the table, where I always fed it with insects of all sorts. It was fondest of flesh maggots, which I kept in bran; it would follow them, and when within a proper distance, would fix its eyes, and remain motionless for near a quarter of a minute, as if preparing for the stroke, which was an instantaneous throwing its tongue at a great distance upon the insect, which stuck to the tip by a glutinous matter. The motion is quicker than the eye can follow. I cannot say how long my father had been acquainted with the toad before I knew it; but when I was first acquainted with it, he used to mention it as the old toad I have known so many years. I can answer for thirty-six years. This old toad made its appearance as soon as the warm weather came; and I always concluded it retired to some dry bank to repose till spring. When we new-laid the steps, I had two holes made on the third step, on each with a hollow of more than a yard long for it; in which I imagine it slept, as it came from thence at its first appearance. It was seldom provoked. Neither that toad, nor the multitudes I have seen tormented with great cruelty, ever showed the least desire of revenge, by spitting or emitting any juice from their pimples. Sometimes, upon taking it up, it would let out a great quantity of clear water, which, as I have often seen it do the same upon the steps when quite quiet, was certainly its urine, and no more than a natural evacuation. Spiders, millepedes, and flesh maggots, seem to be this animal's favourite food. I imagine, if a bee was to be put before a toad, it would certainly eat it to its cost;* but as bees are seldom stirring at the same time that toads are, they rarely come in their way, as they do not appear after sun-rising, or before sun-set. In the heat of the day they will come to the mouth of their hole, I believe for air. I once, from my parlour window, observed a large toad I had in the bank of a bowling-green, about twelve at noon, in a very hot day, very busy and active upon the grass. So uncommon an appearance made me go out to see what it was, when I found an innumerable swarm of winged ants had dropped round his hole, which temptation was as irresistible as a turtle would be to a luxurious alderman. In respect to its end, had it not been for a tame raven, I make no doubt but it would have been now living. This bird one day seeing it at the mouth of its hole, pulled it out, and, although I rescued it, pulled out one eye, and hurt it so, that notwithstanding its living a

* Rœsal tried a frog: it swallowed the bee alive; its stomach was stung, and the animal vomited it up again.

twelvemonth, it never enjoyed itself, and had a difficulty of taking its food, missing the mark for want of its eye. Before that accident, it had all the appearance of perfect health."

To this account of the toad's inoffensive qualities, I will add another from Valisnieri, to show, than even taken internally the toad is no way dangerous. "In the year 1692, some German soldiers, who had taken possession of the castle of Arceti, finding that the peasants of the country often amused themselves in catching frogs, and dressing them for the table, resolved to provide themselves with a like entertainment, and made preparations for frog-fishing in the same manner. It may easily be supposed, that the Italians and their German guests were not very fond of each other, and indeed it is natural to think that the soldiers gave the poor people of the country many good reasons for discontent. They were not a little pleased, therefore, when they saw them go to a ditch where toads instead of frogs were found in abundance. The Germans, no way distinguishing in their sport, caught them in great numbers; while the peasants kept looking on, silently flattering themselves with the hopes of speedy revenge. After being brought home, the toads were dressed up after the Italian fashion, the peasants quite happy at seeing their tyrants devour them with so good an appetite, and expecting every moment to see them drop down dead. But what was their surprise to find that the Germans continued as well as ever, and only complained of a slight excoriation of the lips, which probably arose from some other cause than that of their repast."

I will add another story from Solenandar, who tells us that a tradesman of Rome and his wife had long lived together with mutual discontent; the man was dropsical, and the woman amorous: this ill-matched society promised soon, by the very infirm state of the man, to have an end; but the woman was unwilling to wait the progress of the disorder, and therefore concluded, that to get rid of her husband, nothing was left her but poison. For this purpose, she chose out a dose that she supposed would be the most effectual; and having calcined some toads, mixed their powder with his drink. The man, after taking a hearty dose, found no considerable inconvenience, except that it greatly promoted urine. His wife, who considered this as a beginning symptom of the venom, resolved not to stint the next dose, but gave it in greater quantities than before. This also increased the former symptom; and in a few days the woman had the mortification to see her detested husband restored to perfect health, and remained in utter despair of ever being a widow.

From all this it will appear with what injustice this animal has hitherto been treated. It has undergone every sort of reproach; and mankind have been taught to consider as an enemy a creature that destroys that insect tribe which are their real invaders. We are to treat, therefore, as fables those accounts that represent the toad possessed of poison to kill at a distance; of its ejecting its

venom, which burns wherever it touches; of its infecting those vegetables near which it resides; of its excessive fondness for sage, which it renders poisonous by its approach: these, and a hundred others of the same kind, probably took rise from an antipathy which some have to all animals of the kind. It is a harmless defenceless creature, torpid and unvenomous, and seeking the darkest retreats, not from the malignity of its nature, but the multitude of its enemies.

Like all of the frog kind, the toad is torpid in winter. It chooses then for a retreat either the hollow root of a tree, the cleft of a rock, or sometimes the bottom of a pond, where it is found in a state of seeming insensibility. As it is very long-lived, it is very difficult to be killed: its skin is tough, and cannot be easily pierced; and though covered with wounds the animal continues to show signs of life, and every part appears in motion. But what shall we say to its living for centuries lodged in the bosom of a rock, or cased within the body of an oak tree, without the smallest access on any side either for nourishment or air, and yet taken out alive and perfect! Stories of this kind it would be as rash to contradict as difficult to believe; we have the highest authorities bearing witness to their truth, and yet the whole analogy of nature seems to arraign them of falsehood. Bacon asserts that toads are found in this manner; Dr. Plot asserts the same. There is to this day a marble chimney-piece at Chatsworth with the print of the toad upon it, and a tradition of the manner in which it was found. In the Memoirs of the Academy of Sciences there is an account of a toad found alive and healthy in the heart of a very thick elm, without the smallest entrance or egress.* In the year 1731 there was another found near Nantes in the heart of an old oak, without the smallest issue to its cell; and the discoverer was of opinion, from the size of the tree, that the animal could not have been confined there less than eighty or a hundred years without subsistence and without air. To all these we can only oppose the strangeness of the facts; the necessity this animal appears under of receiving air; and its dying like all other animals in the air pump when deprived of this all-sustaining fluid. But whether these be objections to weigh against such a respectable and disinterested authority, I will not pretend to determine; certain it is, that if kept in a damp place the toad will live for several months without any food whatsoever.

To this extraordinary account, which is doubtful, I will add another not less so; which is that of toads sucking cancerous breasts, and thus extracting the venom and performing a cure. The first account we have of this is in a letter to the Bishop of Carlisle from Dr. Pitfield, who was the first person of consequence that attended the experiment. His letter is as follows:

"Your Lordship must have taken notice of a paragraph in the papers with regard to the application of toads to a cancered breast.

* *Vide* the year 1719.

A patient of mine has sent to the neighbourhood of Hungerford, and brought down the very woman on whom the cure was done. I have, with all the attention I am capable of, attended the operation for eighteen or twenty days, and am surprised at the phenomenon. I am in no expectation of any great service from the application; the age, constitution, and thoroughly cancerous condition of the person, being unconquerable barriers to it. How an ailment of that kind, absolutely local, in an otherwise sound habit, and of a likely age, might be relieved, I cannot say. But as to the operation, thus much I can assert, that there is neither pain nor nauseousness in it. The animal is put into a linen bag all but its head, and that is held to the part. It has generally instantly laid hold of the foulest part of the sore, and sucked with greediness till it dropped off dead. It has frequently happened that the creature has swoln immediately, and from its agonies appeared to be in great pain. I have weighed them for several days together, before and after their application, and found their increase of weight, in their different degrees, from a drachm to near an ounce. They frequently sweat exceedingly, and turn quite pale; sometimes they disgorge, recover, and become lively again. I think the whole scene is surprising, and a very remarkable piece of natural history. From the constant inoffensiveness which I have observed in them, I almost question the truth of their poisonous spitting. Many people here expect no great good from the application of toads to cancers; and where the disorder is not absolutely local, none is to be expected. When it is seated in any part not to be well come at for extirpation, I think it is hardly to be imagined but that the having it sucked clean as often as you please must give relief. Every body knows that dogs licking of sores cures them, which is, I suppose, chiefly by keeping them clean. If there is any credit to be given to history, poisons have been sucked out. *Pallentia vulnera lambit ore venena trahens*, are the words of Lucan on the occasion. If the people to whom these words are applied did their cure by immediately following the injection of the poison, the local confinement of another poison brings the case to a great degree of similarity. I hope I have not tired your Lordship with my long tale: as it is a true one, and in my apprehension a curious piece of natural history, I could not forbear communicating it to you. I own I thought the story in the papers to be an invention; and when I considered the instinctive principle in all animals of self-preservation, I was confirmed in my disbelief: but what I have related I saw; and all the theory must yield to fact. It is only the *rubeth*, the land-toad, which has the property of sucking: I cannot find any the least mention of the property in any one of the old naturalists. My patient can bear to have but one applied in twenty-four hours. The woman who was cured had them on day and night without intermission for five weeks. Their time of hanging at the breast has been from one to six hours."

Other remarks made upon their method of performing this ex-

traordinary operation are as follow: "Some toads die very soon after they have sucked, others live about a quarter of an hour, and some much longer. For example, one that was applied about seven o'clock sucked till ten, and died as soon as it was taken from the breast; another that immediately succeeded continued till three o'clock, but dropped dead from the wound: each swelled exceedingly, and of a pale colour. They do not seem to suck greedily, and often turn their heads away; but during the time of their sucking they were heard to smack their lips like a young child."*

From this circumstantial account of the progress of this extraordinary application, one could hardly suppose that any doubt could remain of the ingenious observer's accuracy; and yet, from information which I have received from authority still more respectable, there is much reason as yet to suspend our assent. A lady, who was under the care of the present president of the College of Physicians, was induced by her friends to try the experiment; and as he saw the case was desperate, and that it would quiet her mind as well as theirs, he permitted the trial. During the whole continuance of their application, she could never thoroughly perceive that they sucked her; but that did not prevent their swallowing and dying, as in the former instances. Once, indeed, she said, she thought that one of them seemed to suck; but the physician, and those who attended, could not perceive any appearance of it. Thus, after all, it is a doubt whether these animals die by the internal or the external application of the cancerous poison.

Of this animal there are several varieties; such as the Water and the Land Toad, which probably differ only in the ground-colour of their skin. In the first it is more inclining to ash colour, with brown spots; in the other, the colour is brown, approaching to black. The water toad is not so large as the other; but both equally breed in that element. The size of the toad, with us, is generally from two to four inches long; but in the fenny countries of Europe I have seen them much larger, and not less than a common crab, when brought to table. But this is nothing to what they are found in some of the tropical climates, where travellers often, for the first time, mistake a toad for a tortoise. Their usual size is from six to seven inches; but there are some still larger, and as broad as a plate. Of these some are beautifully streaked and coloured; some studded over, as with pearls; others bristled with horns or spines; some have the head distinct from the body, while others have it so sunk in, that the animal appears without a head. All these are found in the tropical climates in great abundance, and particularly after a shower of rain. It is then that the streets seem entirely paved with them; they then crawl from their retreats, and go into all places, to enjoy their favourite moisture. With us, the opinion of its raining toads and frogs

* British Zoology, vol. iii. p. 338.

has long been justly exploded; but it still is entertained in the tropical countries, and that not only by the savage natives, but the more refined settlers, who are apt enough to add the prejudices of other nations to their own.

It would be a tedious, as well as an useless task, to enter into all the minute discriminations of these animals, as found in different countries or places; but the Pipal, or the Surinam Toad, is too strange a creature not to require an exact description.—There is not, perhaps, in all nature, a more extraordinary phenomenon, than that of an animal breeding and hatching its young in its back; from whence, as from a kind of hot-bed, they crawl, one after the other, when come to maturity.

The pipal is in form more hideous than even the common toad, nature seeming to have marked all those strange mannered animals with peculiar deformity. The body is flat and broad; the head small; the jaws, like those of a mole, are extended, and evidently formed for rooting in the ground; the skin of the neck forms a sort of wrinkled collar; the colour of the head is of a dark chesnut, and the eyes are small; the back, which is very broad, is of a lightish grey, and seems covered over with a number of small eyes, which are round, and placed at nearly equal distances. These eyes are very different from what they seem; they are the animal's eggs, covered with their shells, and placed there for hatching. These eggs are buried deep in the skin, and in the beginning of incubation but just appear; and are very visible when the young animal is about to burst from its confinement. They are of a reddish shining yellow colour; and the spaces between them are full of small warts, resembling pearls.

This is their situation previous to their coming forth; but nothing so much demands our admiration as the manner of their production. The eggs, when formed in the ovary, are sent, by some internal canals, which anatomists have not hitherto described, to lie and come to maturity under the bony substance of the back: in this state they are impregnated by the male, whose seed finds its way by pores very singularly contrived, and pierces not only the skin, but the periosteum: the skin, however, is still apparently entire, and forms a very thick covering over the whole brood; but as they advance to maturity, at different intervals, one after the other, the egg seems to start forward and bourgeon from the back, becomes more yellow, and at last breaks, when the young one puts forth its head: it still, however, keeps its situation, until it has acquired a proper degree of strength, and then it leaves the shell, but still continues to keep upon the back of the parent. In this manner the pipal is seen travelling with her wondrous family on her back, in all the different stages of maturity. Some of the strange progeny, not yet come to sufficient perfection, appear quite torpid, and as yet without life, in the egg; others seem just beginning to rise through the skin, here peeping forth from the shell, and there having entirely forsaken their prison; some are

sporting at large upon the parent's back, and others descending to the ground, to try their own fortune below.

Such is the description given us of this strange production by Seba; in which he differs from Ruysch, who affirms that the young ones are bred in the back of the male only, where the female lays her eggs. I have followed Seba, however; not because he is better authority, but because he is more positive of the truth of his account, and asserts, assuredly, that the eggs are found on the back of the female only. Many circumstances, however, are wanting towards completing his information; such as a description of the passage by which the egg finds its way into the back; the manner of its fecundation; the time of gestation; as also a history of the manners of this strange animal itself; but by a prolixity that too much prevails among naturalists at present, he leaves the most interesting object of curiosity, to give us a detailed description of the legs and claws of the pipal, about which we have very little concern.

The male pipal is every way larger than the female, and has the skin less tightly drawn round the body. The whole body is covered with pustules, resembling pearls; and the belly, which is of a bright yellow, seems as if it were sewed up from the throat to the vent, a seam being seen to run in that direction. This animal, like the rest of the frog kind, is most probably harmless; though we are told of the terrible effects resulting from its powder when calcined. This, however, must certainly be false: no creature whatever, when calcined, can be poisonous; for the fire burns away whatever might have been dangerous in their composition: all animal substances, when calcined, being entirely the same.

CHAPTER IV.

OF LIZARDS IN GENERAL.

There is scarcely a naturalist who has treated of Lizards, but has a particular manner of ranking them in the scale of animated nature. Ray, rather struck with the number of their legs than their habits and conformation, has exalted them among quadrupeds; while Linnæus, attentive only to their long slender forms, has degraded them among serpents. Brisson gives them a distinct class by themselves, under the name of Reptiles. Klein gives them a class inferior to beasts, under the name of Naked Quadrupeds. Some, in short, from their scaly covering, and fondness for the water, have given them to the fishes; while there have not been wanting naturalists who have classed them with insects, as the smaller kinds of this class seem to demand.

It is indeed no easy matter to tell to what class in nature lizards are chiefly allied. They are unjustly raised to the rank of beasts—

as they bring forth eggs, dispense with breathing, and are not covered with hair:—They cannot be placed among fishes, as the majority of them live upon land; they are excluded from the serpent tribe by their feet, upon which they run with some celerity; and from the insects by their size; for though the Newt may be looked upon in this contemptible light, a Crocodile would be a terrible insect indeed. Thus lizards are, in some measure, excluded from every rank, while they exhibit somewhat of the properties of all: the legs and celerity of the quadruped; a facility of creeping through narrow and intricate ways, like the serpent; and a power of living in the water, like fishes: however, though endued with these various powers, they have no real advantages over any other class of animated nature; for what they gain in aptitude for one element, they lose in their fitness for another. Thus, between both, they are an awkward, ungainly tribe; neither so alert upon land, nor so nimble in the water, as the respective inhabitants of either abode: and, indeed, this holds throughout all nature, that, in proportion as the seeming advantages of inferior animals are multiplied, their real ones are abridged; and all their instincts are weakened and lost by the variety of channels into which they are divided.

As lizards thus differ from every other class of animals, they also differ widely from each other. With respect to size, no class of beings has its ranks so opposite. What, for instance, can be more removed than the small Cameleon, an inch long, and the Alligator of the river Amazons, above twenty-seven feet? To an inattentive observer, they would appear entirely of different kinds; and Seba wonders how they ever came to be classed together.

The colour of these animals also is very various, as they are found of a hundred different hues, green, blue, red, chesnut, yellow, spotted, streaked, and marbled. Were colour alone capable of constituting beauty, the lizard would often please; but there is something so repressing in the animal's figure, that the brilliancy of its scales, or the variety of its spots, only tend to give an air of more exquisite venom, of greater malignity. The figure of these animals is not less various: sometimes swoln in the belly; sometimes pursed up at the throat; sometimes with a rough set of spines on the back, like the teeth of a saw; sometimes with teeth, at others with none; sometimes venomous,* at others harmless, and even philanthropic; sometimes smooth and even; sometimes with a long slender tail, and often with a shorter blunt one.

But their greatest distinction arises from their manner of bringing forth their young. Firstly, some of them are viviparous. Secondly, some are oviparous; and which may be considered in three distinct ways. Thirdly, some bring forth small spawn, like fishes. The Crocodile, the Iguana, and all the large kinds, bring

[* It is now known that none of these animals are provided with poison, and, excepting the alligator and crocodile, they are perfectly harmless.

forth eggs, which are hatched by the heat of the sun: the animals that issue from them are complete upon leaving the shell, and their first efforts are to run to seek food in their proper element. The viviparous kinds, in which are all the salamanders, come forth alive from the body of the female, perfect and active, and suffer no succeeding change. But those which are bred in the water, and as we have reason to think, from spawn, suffer a very considerable change in their form. They are produced with an external skin or covering, that sometimes encloses their feet, and gives them a serpentine appearance. To this false skin, fins are added, above and below the tail, that serve the animal for swimming; but when the false skin drops off, these drop off also; and then the lizard, with its four feet, is completely formed, and forsakes the water.

From hence it appears, that of this tribe there are three distinct kinds, differently produced, and most probably very different in their formation. But the history of these animals is very obscure, and we are as yet incapable of laying the line that separates them. All we know, as was said before, is, that the great animals of this kind are *mostly* produced perfect from the egg: the salamanders are *generally* viviparous; and *some* of the water lizards imperfectly produced. In all these most unfinished productions of nature, if I may so call them, the varieties in their structure increase in proportion to their imperfections. A poet would say, that nature grew tired of the nauseous formation, and left accident to finish the rest of her handy-work.

However, the three kinds have many points of similitude; and in all their varieties of figure, colour, and production, this tribe is easily distinguished, and strongly marked. They have all four short legs; the two fore feet somewhat resembling a man's hand and arm. They have tails almost as thick as the body at the beginning, and that generally run tapering to a point. They are all amphibious also, equally capable of living upon land and water, and formed internally in the same manner with the tortoise, and other animals that can continue a long time without respiration: in other words, their lungs are not so necessary to continue life and circulation, but that their play may be stopped for some considerable time, while the blood performs its circuit round the body by a shorter communication.

These are differences that sufficiently separate lizards from all other animals; but it will be very difficult to fix the limits that distinguish the three kinds from each other. The *crocodile* tribe, and its affinities, are sufficiently distinguished from all the rest by their size and fierceness; the *salamander* tribe is distinguished by their deformity, their frog-like heads, the shortness of their snouts, their swoln bellies, and their viviparous production. With regard to the rest, which we may denominate the *cameleon*, or *lizard kind*, some of which bring forth from the egg, and some of which are imperfectly formed from spawn, we must group them under one head, and leave time to unravel the rest of their history.

CROCODILE'S EGG.

SEA URCHIN.

CHAPTER V.

OF THE CROCODILE, AND ITS AFFINITIES.

The Crocodile is an animal placed at a happy distance from the inhabitants of Europe, and formidable only in those regions where men are scarce, and arts but little known. In all the cultivated and populous parts of the world, the great animals are entirely banished, or rarely seen. The appearance of such raises at once a whole country up in arms to oppose their force, and their lives generally pay the forfeit of their temerity. The crocodile, therefore, that was once so terrible along the banks of the river Nile, is now neither so large, nor its number so great as formerly. The arts of mankind have, through a course of ages, powerfully operated to its destruction; and, though it is sometimes seen, it appears comparatively timorous and feeble.

To look for this animal in all its natural terrors, grown to an enormous size, propagated in surprising numbers, and committing unceasing devastations, we must go to the uninhabited regions of Africa and America, to those immense rivers that roll through extensive and desolate kingdoms, where arts have never penetrated, where force only makes distinction, and the most powerful animals exert their strength with confidence and security. Those that sail up the river Amazons, or the river Niger, well know how numerous and terrible those animals are in such parts of the world. In both these rivers, they are found from eighteen to twenty-seven feet long; and sometimes lying as close to each other as a raft of timber upon one of our streams. There they indolently bask on the surface, no way disturbed at the approach of an enemy, since, from the repeated trials of their strength, they find none that they are not able to subdue.

Of this terrible animal there are two kinds; the Crocodile, properly so called, and the Cayman or Alligator. Travellers, however, have rather made the distinction than nature; for in the general outline, and in the nature of these two animals, they are entirely the same. It would be speaking more properly to call these animals the crocodiles of the eastern and the western world; for in books of voyages they are so entirely confounded together, that there is no knowing whether the Asiatic animal be the Crocodile of Asia, or the Alligator of the western world. The distinctions usually made between the crocodile and alligator are these:—the body of the crocodile is more slender than that of the alligator; its snout runs off tapering from the forehead, like that of a greyhound, while that of the other is indented, like the nose of a lap-dog. The crocodile has a much wider swallow, and is of an ash colour; the alligator is black, varied with white, and is thought not to be so mischievous. All these distinctions, however,

are very slight, and can be reckoned little more than minute variations.

This animal grows to a great length, being sometimes found thirty feet long from the tip of the snout to the end of the tail; its most usual length, however, is eighteen. One which was dissected by the Jesuits at Siam was of the latter dimensions; and as the description which is given of it, both externally and internally, is the most accurate known of this noted animal, I must beg leave to give it as I find it, though somewhat tedious. It was eighteen feet and a half French measure, in length; of which the tail was no less than five feet and a half, and the head and neck about two feet and a half. It was four feet nine inches in circumference where thickest. The fore-legs had the same parts and conformation as the arms of a man, both within and without. The hands, if they may be so called, had five fingers, the two last of which had no nails, and were of a conical figure. The hinder legs, including the thigh and paw, were two feet two inches long; the paws, from the joint to the extremity of the longest claws, were above nine inches: they were divided into four toes, of which three were armed with long claws, the longest of which was an inch and a half; these toes were united by a membrane, like those of a duck, but much thicker. The head was long, and had a little rising at the top; but the rest was flat, and especially towards the extremity of the jaws. It was covered by a skin, which adhered firmly to the skull and to the jaws. The skull was rough and unequal in several places; and about the middle of the forehead there were two bony crests, about two inches high; the skull between these two crests was proof against a musket-ball, for it only rendered the part a little white that it struck against. The eye was very small, in proportion to the rest of the body, and was so placed within its orbit, that the outward part, when the lid was closed, was only an inch long, and the line running parallel to the opening of the jaws. It was covered with a double lid, one within and one without; that within, like the nictitating membrane in birds, was folded in the great corner of the eye, and had a motion towards the tail, but being transparent, it covered the eye without hindering the sight. The iris was very large in proportion to the globe of the eye, and was of a yellowish-grey colour. Above the eye the ear was placed, which opened from above downwards, as if it were by a kind of spring, by means of a solid, thick, cartilaginous substance. The nose was placed in the middle of the upper jaw, near an inch from its extremity, and was perfectly round and flat, being near two inches in diameter, of a black, soft, spongy substance, not unlike the nose of a dog. The jaws seemed to shut one within another; and nothing can be more false than that the animal's under jaw is without motion; it moves, like the lower jaw in all other animals, while the upper is fixed to the skull, and absolutely immoveable. The animal had twenty-seven cutting teeth in the upper jaw, and fifteen in the

lower, with several void spaces between them: they were thick at the bottom, and sharp at the point, being all of different sizes, except ten large hooked ones, six of which were in the lower jaw, and four in the upper. The mouth was fifteen inches in length, and eight and a half in breadth, where broadest. The distance of the two jaws, when opened as wide as they could be, was fifteen inches and a half; this is a very wide yawn, and could easily enough take in the body of a man. The colour of the body was of a dark brown on the upper part, and of a whitish citron below, with large spots of both colours on the sides. From the shoulders to the extremity of the tail, the animal was covered with large scales, of a square form, disposed like parallel girdles, and fifty-two in number; but those near the tail were not so thick as the rest. The creature was covered not only with these, but all over with a coat of armour; which, however, was not proof against a musket-ball, contrary to what has been commonly asserted: however, it must be confessed, that the attitude in which the animal was placed, might contribute to render the skin more penetrable; for probably if the ball had struck obliquely against the shell, it would have flown off. Those parts of the girdles underneath the belly were of a whitish colour, and were made up of scales of divers shapes, but not so hard as those on the back.

With respect to the internal parts of the animal, the gullet was large in proportion to the mouth; and a ball of wood, as large as one's head, readily ran down, and was drawn up again. The guts were but short in comparison, being not so long as the animal's body. The tongue, which some have erroneously asserted this animal was without, consisted of a thick spongy soft flesh, and was strongly connected to the lower jaw. The heart was of the size of a calf's, of a bright red colour, the blood passing as well from the veins to the aorta as into the lungs. There was no bladder; but the kidneys sent the urine to be discharged by the anus. There were sixty-two joints in the back-bone, which, though very closely united, had sufficient play to enable the animal to bend like a bow to the right and the left; so that what we hear of escaping the creature by turning out of the right line, and of the animal not being able to wheel readily after its prey, seems to be fabulous. It is most likely the crocodile can turn with ease, for the joints of its back are not stiffer than those of other animals, which we know by experience can wheel about very nimbly for their size.

Such is the figure and conformation of this formidable animal, that unpeoples countries, and makes the most navigable rivers desert and dangerous. They are seen in some places lying for whole hours, and even days, stretched in the sun, and motionless; so that one not used to them might mistake them for trunks of trees, covered with a rough and dry bark: but the mistake would soon be fatal if not prevented; for the torpid animal, at the near approach of any living thing, darts upon it with instant swiftness,

and at once drags it down to the bottom. In the times of an inundation they sometimes enter the cottages of the natives, where the dreadful visitant seizes the first animal it meets with. There have been several examples of their taking a man out of a canoe in the sight of his companions, without their being able to lend him any assistance.

The strength of every part of the crocodile is very great; and its arms, both offensive and defensive, irresistible. We have seen from the shortness of its legs, the amazing strength of the tortoise; but what is the strength of such an animal compared to that of the crocodile, whose legs are very short, and whose size is so superior? The back-bone is jointed in the firmest manner, the muscles of the fore and hinder legs are vigorous and strong, and its whole form calculated for force. Its teeth are sharp, numerous, and formidable; its claws are long and tenaceous: but its principal instrument of destruction is the tail—with a single blow of this it has often overturned a canoe, and seized upon the poor savage its conductor.

Though not so powerful, yet it is very terrible even upon land. The crocodile seldom, except when pressed by hunger, or with a view of depositing its eggs, leaves the water. Its usual method is to float upon the surface, and seize whatever animals come within its reach; but when this method fails, it then goes closer to the bank. Disappointed of its fishy prey, it there waits covered up among the sedges in patient expectation of some land animal that comes to drink, the dog, the bull, the tiger, or man himself. Nothing is to be seen of the insidious destroyer as the animal approaches, nor is its retreat discovered till it be too late for safety. It seizes the victim with a spring, and goes at a bound much faster than so unwieldy an animal could be thought capable of exerting; then, having secured the creature with both teeth and claws, it drags it into the water, instantly sinks with it to the bottom, and in this manner quickly drowns it.

Sometimes it happens, that the creature the crocodile has thus surprised escapes from its grasp wounded, and makes off from the river side. In such a case the tyrant pursues with all its force, and often seizes it a second time; for though seemingly heavy, the crocodile runs with great celerity. In this manner it is sometimes seen above half a mile from the bank in pursuit of an animal wounded beyond the power of escaping, and then dragging it back to the river side, where it feasts in security.

It often happens, in its depredations along the bank, that the crocodile seizes on a creature as formidable as itself, and meets with a most desperate resistance. We are told of frequent combats between the crocodile and the tiger. All creatures of the tiger kind are continually oppressed by a parching thirst, that keeps them in the vicinity of great rivers, whither they descend to drink very frequently. It is upon these occasions that they are seized by the crocodile, and they die not unrevenged. The instant they are

seized upon, they turn with the greatest agility, and force their claws into the crocodile's eyes, while he plunges with his fierce antagonist into the river. There they continue to struggle for some time, till at last the tiger is drowned.

In this manner the crocodile seizes and destroys all animals, and is equally dreaded by all. There is no animal but man alone that can combat it with success. We are assured by Labat, that a Negro, with no other weapons than a knife in his right hand, and his left arm wrapped round with a cow hide, ventures boldly to attack this animal in its own element. As soon as he approaches the crocodile, he presents his left arm, which the animal swallows most greedily; but sticking in his throat, the Negro has time to give it several stabs under the throat; and the water also getting in at the mouth, which is held involuntarily open, the creature is soon bloated up as big as a tun, and expires.

To us who live at a distance from the rapacity of these animals, these stories appear strange, and yet most probably are true. From not having seen any thing so formidable or bold in the circle of our own experience, we are not to determine upon the wonderful transactions in distant climates. It is probable that these, and a number of more dreadful encounters, happen every day among those forests and in those rivers where the most formidable animals are known to reside; where the elephant and the rhinoceros, the tiger and the hippopotamus, the shark and the crocodile, have frequent opportunities of meeting, and every day of renewing their engagements.

Whatever be the truth of these accounts, certain it is that crocodiles are taken by the Siamese in great abundance. The natives of that empire seem particularly fond of the capture of all the great animals with which their country abounds. We have already seen their success in taking and taming the elephant, nor are they less powerful in exerting their dominion over the crocodile. The manner of taking it in Siam is by throwing three or four strong nets across a river at proper distances from each other, so that if the animal breaks through the first, it may be caught by one of the rest. When it is first taken, it employs the tail, which is the grand instrument of strength, with great force; but, after many unsuccessful struggles, the animal's strength is at last exhausted. Then the natives approach their prisoner in boats, and pierce him with their weapons in the most tender parts, till he is weakened with the loss of blood. When he has done stirring, they begin by tying up his mouth, and with the same cord they fasten his head to the tail, which last they bend back like a bow. However, they are not yet perfectly secure from his fury, but for their greater safety, they tie his fore-feet, as well as those behind, to the top of his back. These precautions are not useless, for if they were to omit them, the crocodile would soon recover strength enough to do a great deal of mischief.

The crocodile thus brought into subjection, or bred up young, is used to divert and entertain the great men of the East. It is often managed like a horse; a curb is put into its mouth, and the rider directs it as he thinks proper. Though awkwardly formed, it does not fail to proceed with some degree of swiftness; and is thought to move as fast as some of the most unweildy of our own animals, the hog or the cow. Some, indeed, assert that no animal could escape it, but for its difficulty in turning; but to this resource we could wish none would trust who are so unhappy as to find themselves in danger.

Along the rivers of Africa this animal is sometimes taken in the same manner as the shark: several Europeans go together in a large boat, and throw out a piece of beef upon a hook and strong fortified line, which the crocodile seizing, and swallowing, is drawn along, floundering and struggling, until its strength is quite exhausted, when it is pierced in the belly, which is its tenderest part; and thus after numberless wounds is drawn ashore. In this part of the world also, as well as at Siam, the crocodile makes an object of savage pomp near the palaces of their monarchs. Philips informs us that at Sabi, on the Slave Coast, there are two pools of water near the royal palace, where crocodiles are bred, as we breed carp in our ponds in Europe.

Hitherto I have been describing the crocodile as it is found in unpeopled countries, and undisturbed by frequent encounters with mankind. In this state it is fierce and cruel, attacking every object that seems endued with motion; but in Egypt, and other countries long peopled, where the inhabitants are civilized, and the rivers frequented, this animal is solitary and fearful. So far from coming to attack a man, it sinks at his approach with the utmost precipitation; and, as if sensible of superior power, ever declines the engagement. We have seen more than one instance in animated nature of the contempt which at first the lower orders of the creation have for man, till they have experienced his powers of destruction. The lion and the tiger among beasts, the whale among fishes, the albatross and the penguin among birds, meet the first encounters of man without dread or apprehension; but they soon learn to acknowledge his superiority, and take refuge from his power in the deepest fastnesses of nature. This may account for the different characters which have been given us of the crocodile and the alligator by travellers at different times: some describing them as harmless and fearful, as ever avoiding the sight of a man, and preying only upon fishes; others ranking them among the destroyers of nature, describing them as furnished with strength and impelled by malignity to do mischief, representing them as the greatest enemies of mankind, and particularly desirous of human prey. The truth is, the animal has been justly described by both, being such as it is found in places differently peopled or differently civilized. Wherever the crocodile has

reigned long unmolested, it is there fierce, bold, and dangerous; wherever it has been harassed by mankind, its retreats invaded, and its numbers destroyed, it is there timorous and inoffensive.

In some places, therefore, this animal, instead of being formidable, is not only inoffensive, but is cherished and admired. In the river San Domingo, the crocodiles are the most inoffensive animals in nature; the children play with them, and ride about on their backs; they even beat them sometimes without receiving the smallest injury. It is true the inhabitants are very careful of this gentle breed, and consider them as harmless domestics.

It is probable that the smell of musk, which all these animals exhale, may render them agreeable to the savages of that part of Africa. They are often known to take the part of this animal which contains the musk, and wear it as a perfume about their persons. Travellers are not agreed in what part of the body these musk bags are contained; some say in the ears, some in the parts of generation; but the most probable opinion is, that this musky substance is amassed in the glands under the legs and arms. From whatsoever part of the body this odour proceeds, it is very strong and powerful, tincturing the flesh of the whole body with its taste and smell. The crocodile's flesh is at best very bad, tough eating; but unless the musk bags be separated, it is insupportable. The Negroes themselves cannot well digest the flesh; but then, a crocodile's egg is to them the most delicate morsel in the world. Even savages exhibit their epicures as well as we; and one of true taste will spare neither pains nor danger to furnish himself with his favourite repast. For this reason, he often watches the places where the female comes to lay her eggs, and upon her retiring seizes the booty.

All crocodiles breed near fresh waters; and though they are sometimes found in the sea, yet that may be considered rather as a place of excursion than abode. They produce their young by eggs, as was said above; and for this purpose the female, when she comes to lay, chooses a place by the side of a river, or some fresh water lake, to deposit her brood in. She always pitches upon an extensive sandy shore, where she may dig a hole without danger of detection from the ground being fresh turned up. The shore must also be gentle and shelving to the water, from the greater convenience of the animal's going and returning; and a convenient place must be found near the edge of the stream, that the young may have a shorter way to go. When all these requisities are adjusted, the animal is seen cautiously stealing upon shore to deposit her burden. The presence of a man, a beast, or even a bird, is sufficient to deter her at that time; and if she perceives any creature looking on, she infallibly returns. If, however, nothing appears, she then goes to work, scratching up the sand with her fore-paws, and making a hole pretty deep in the shore.—There she deposits from eighty to a hundred eggs, of the size of a tennis ball, and of the same figure, covered with a tough white skin

like parchment. She takes above an hour to perform this task; and then covering up the place so artfully that it can scarcely be perceived, she goes back, to return again the next day. Upon her return, with the same precaution as before she lays about the same number of eggs, and the day following also a like number. Thus having deposited her whole quantity, and having covered them close up in the sand, they are soon vivified by the heat of the sun, and at the end of thirty days the young ones begin to break open the shell. At this time the female is instinctively taught that her young ones want relief; and she goes upon land to scratch away the sand and set them free. Her brood quickly avail themselves of their liberty; a part run unguided to the water, another part ascend the back of the female, and are carried thither in greater safety. But the moment they arrive at the water, all natural connexion is at an end: when the female has introduced her young to their natural element, not only she, but the male, become among the number of their most formidable enemies, and devour as many of them as they can. The whole brood scatters into different parts at the bottom; by far the greatest number are destroyed, and the rest find safety in their agility or minuteness.

But it is not the crocodile alone that is thus found to thin their numbers; the eggs of this animal are not only a delicious feast to the savage, but are eagerly sought after by every beast and bird of prey. The ichneumon was erected into a deity among the ancients for its success in destroying the eggs of these monsters; at present that species of the vulture called the Gallinazo is their most prevailing enemy. All along the banks of great rivers, for thousands of miles, the crocodile is seen to propagate in numbers that would soon overrun the earth, but for the vulture, that seems appointed by Providence to abridge its fecundity. These birds are ever found in greatest numbers where the crocodile is most numerous; and hiding themselves within the thick branches of the trees that shade the banks of the river, they watch the female in silence, and permit her to lay all her eggs without interruption. Then when she has retired, they encourage each other with cries to the spoil; and flocking all together upon the hidden treasure, tear up the eggs, and devour them in a much quicker time than they were deposited. Nor are they less diligent in attending the female while she is carrying her young to the water, for if any one of them happens to drop by the way, it is sure to receive no mercy.

Such is the extraordinary account given us by the late travellers of the propagation of this animal; an account adopted by Linnæus and the most learned naturalists of the age.* Yet, if one might argue from the general analogy of nature, the crocodile's devouring her own young when she gets to the water seems doubtful. This may be a story raised from the general idea of this animal's rapacious cruelty.; when, in fact, the crocodile only seems

* Ulloa.

more cruel than other animals, because it has more power to do mischief. It is probable that it is not more divested of parental tenderness than other creatures; and I am the more led to think so from the peculiar formation of one of the crocodile kind. This is called the Open-bellied Crocodile, and is furnished with a false belly like the opossum, where the young creep out and in as their dangers or necessities require. The crocodile thus furnished at least cannot be said to be an enemy to her own young, since she thus gives them more than parental protection.* It is probable also that this open-bellied crocodile is viviparous, and fosters her young that are prematurely excluded in this second womb, until they come to proper maturity.

How long the crocodile lives we are not certainly informed; if we may believe Aristotle, it lives the age of a man; but the ancients so much amused themselves in inventing fables concerning this animal, that even truth from them is suspicious. What we know for certain from the ancients is, that among the various animals that were produced to fight in the amphitheatre at Rome, the combat of the crocodile was not wanting.† Marcus Scaurus produced them living in his unrivalled exhibitions; and the Romans considered him as the best citizen, because he furnished them with the most expensive entertainments. But entertainment at that corrupt time was their only occupation.

CHAPTER VI.

OF THE SALAMANDER.

THE ancients have described a lizard that is bred from heat, that lives in the flames, and feeds upon fire as its proper nourishment. As they saw every other element, the air, the earth, and water, inhabited, fancy was set to work to find or make an inhabitant in fire, and thus to people every part of nature. It will be needless to say that there is no such animal existing; and that, of all others, the modern Salamander has the smallest affinity to such an abode.

Whether the animal that now goes by the name of the salamander be the same with that described by Pliny, is a doubt with me; but this is not a place for the discussion. It is sufficient to observe, that the modern salamander is an animal of the lizard kind; and under this name is comprehended a large tribe that all

[* This statement respecting the open-bellied crocodile should be received with considerable hesitation, as many modern naturalists assert that none of them have any thing resembling a pouch for securing their young.]

† Plin. lib. viii. c. 26.

go by the same name. There have been not less than seven sorts of this animal described by Seba; and to have some idea of the peculiarity of their figure, if we suppose the tail of the lizard applied to the body of a frog, we shall not be far from precision. The common lizard is long, small, and taper; the salamander, like the frog, has its eyes towards the back part of its head; like the frog, its snout is round and not pointed, and its belly thick and swoln. The claws of its toes are short and feeble; its skin rough; and the tongue, unlike that of the smallest of the lizard kind, in which it is long and forked, is short and adhering to the under jaw.

But it is not in figure that this animal chiefly differs from the rest of the lizard tribe, for it seems to differ in nature and conformation. In nature it is unlike, being a heavy torpid animal, whereas the lizard tribe are active, restless, and ever in motion: in conformation it is unlike, as the salamander is produced alive from the body of its parent, and is completely formed the moment of its exclusion. It differs from them also in its general reputation of being venomous; however, no trials that have been hitherto made seem to confirm the truth of the report.

Not only this, but many others of the lizard tribe, are said to have venom; but it were to be wished that mankind, for their own happiness, would examine into the foundation of this reproach. By that means many of them, that are now shunned and detested, might be found inoffensive; their figure, instead of exciting either horror or disgust, would then only tend to animate the general scene of nature, and speculation might examine their manners in confidence and security. Certain it is, that all of the lizard kind with which we are acquainted in this country are perfectly harmless; and it is equally true, that for a long time, till our prejudices were removed, we considered not only the Newt, but the Snake and the Blind Worm, as fraught with the most destructive poison. At present we have got over these prejudices; and it is probable, that if other nations made the same efforts for information, it would be found, that the malignity of most, if not all of the lizard tribe, was only in the imagination.

With respect to the Salamander, the whole tribe, from the Moron to the Gekko, are said to be venomous to the last degree; yet, when experiments have been tried, no arts, no provocations, could excite these animals to the rage of biting. They seem timid and inoffensive, only living upon worms and insects; quite destitute of fangs, like the viper; their teeth are so very small that they are hardly able to inflict a wound. But as the teeth are thus incapable of offending, the people of the countries where they are found have recourse to a venomous slaver, which they suppose issues from the animal's mouth: they also tell us of a venom issuing from the claws; even Linnæus seems to acknowledge the fact, but thinks it a probable supposition that this venom may proceed from their urine.

Of all animals, the Gekko is the most notorious for its powers of mischief; yet we are told, by those who load it with that calumny, that it is very friendly to man, and though supplied with the most deadly virulence, is yet never known to bite. It would be absurd in us, without experience, to pronounce upon the noxious or inoffensive qualities of animals; yet it is most probable, from an inspection of the teeth of lizards, and from their inoffensive qualities in Europe, that the gekko has been unjustly accused, and that its serpent-like figure has involved it in one common reproach with serpents.

The salamander best known in Europe is from eight to eleven inches long, usually black, spotted with yellow; and when taken in the hand, feeling cold to a great degree. There are several kinds. Our Black Water Newt is reckoned among the number. The idle report of its being inconsumable in fire, has caused many of these poor animals to be burnt; but we cannot say as philosophical martyrs, since scarcely any philosopher could think it necessary to make the experiment. When thrown into the fire, the animal is seen to burst with the heat of its situation, and to eject its fluids. We are gravely told in the Philosophical Transactions, that this is a method the animal takes to extinguish the flames.

When examined internally, the salamander exhibits little difference from other animals of the lizard kind. It is furnished with lungs that sometimes serve for the offices of breathing; with a heart that has its communications open, so that the animal cannot easily be drowned. The ovary in the female is double the size of what it is in others of this tribe; and the male is furnished with four *testiculi* instead of two. But what deserves particular notice, is the manner of this animal's bringing forth its young alive.* "The salamander," says my author, "begins to show itself in the spring, and chiefly during heavy rains. When the warm weather returns, it disappears; and never leaves its hole during either great heats or severe colds, both which it equally fears. When taken in the hand, it appears like a lump of ice; it consequently loves the shade, and is found at the feet of old trees surrounded with brush wood at the bottom. It is fond of running along new ploughed grounds, probably to seek for worms, which are its ordinary food. One of these," continues my author, "I took alive some years ago in a ditch that had been lately made. I laid it at the foot of the stairs upon coming home, and there it disgorged from the throat a *worm* three inches long, that lived for an hour after, though wounded, as I suppose, by the teeth of the animal. I afterwards cut up another of these lizards, and saw not less than fifty young ones, resembling the parent, come from its womb, all alive, and actively running about the room. It were to be wished the author had used another

* Acta Hasniensia, ann. 1676. Observ. 11. Mémoires de l'Académie Royale des Sciences, tom. iii. part. 3. p. 80.

word beside that of *worm*; as we now are in doubt whether he means a real worm, or a young animal of the lizard species: had he been more explicit, and had it appeared that it was a real young lizard, which I take to be his meaning, we might here see a wonder of nature brought to the proof, which many have asserted, and many have thought proper to deny: I mean the refuge which the young of the shark, the lizard, and the viper kinds, are said to take, by running down the throat of the parent, and there finding a temporary security. The fact, indeed, seems a little extraordinary; and yet it is so frequently attested by some, and even believed by others, whose authority is respectable, among the number of whom we find Mr. Pennant, that the argument of strangeness must give way to the weight of authority.

However this be, there is no doubt of the animal's being viviparous, and producing about fifty at a time. They come from the parent in full perfection, and quickly leave her to shift for themselves. These animals in the lower ranks of nature want scarcely any help when excluded; they soon complete the little circle of their education, and in a day or two are capable of practising all the arts of subsistence and evasion practised by their kind.

They are all amphibious, or at least are found capable of subsisting in either element, when placed there: if those taken from land are put into water, they continue there in seeming health; and, on the contrary, those taken from the water will live upon land. In water, however, they exhibit a greater variety in their appearance; and what is equally wonderful with the rest of their history, during the whole spring and summer this water lizard changes its skin every fourth or fifth day, and during the winter every fifteen days. This operation they perform by means of the mouth and the claws; and it seems a work of no small difficulty and pain. The cast skins are frequently seen floating on the surface of the water: they are sometimes seen also with a part of their old skin sticking to one of their limbs, which they have not been able to get rid of: and thus, like a man with a boot half drawn, in some measure crippled in their own spoils. This also often corrupts, and the leg drops off; but the animal does not seem to feel the want of it, for the loss of a limb to all the lizard kind is but a trifling calamity. They can live several hours even after the loss of their head; and for some time under dissection, all the parts of this animal seem to retain life; but the tail is the part that longest retains its motion. Salt seems to be much more efficacious in destroying these animals than the knife; for, upon being sprinkled with it, the whole body emits a viscous liquor, and the lizard dies in three minutes, in great agonies.

The whole of the lizard kind are also tenacious of life in another respect, and the salamander among the number. They sustain the want of food in a surprising manner. One of them, brought from the Indies, lived nine months, without any other food than

what it received from licking a piece of earth on which it was brought over:* another was kept by Seba in an empty vial for six months, without any nourishment: and Redi talks of a large one, brought from Africa, that lived for eight months without taking any nourishment whatever. Indeed, as many of this kind, both salamanders and lizards, are torpid, or nearly so, during the winter, the loss of their appetite for so long a time is the less surprising.

CHAPTER VII.

OF THE CAMELEON, THE IGUANA, AND LIZARDS OF DIFFERENT KINDS.

It were to be wished that animals could be so classed, that by the very mentioning their rank, we should receive some insight into their history. This I have endeavoured in most instances; but in the present chapter all method is totally unserviceable. Here distribution gives no general ideas; for some of the animals to be here mentioned produce by eggs, some by spawn, and some are viviparous. The peculiar manner of propagating in each is very indistinctly known. The Iguana and the Cameleon, we know, bring forth eggs; some others also produce in the same manner: but of the rest, which naturalists make amount to above fifty, we have but very indistinct information.

In the former divisions of this tribe, we had to observe upon animals formidable from their size, or disgusting from their frog-like head and appearance; in the present division, all the animals are either beautiful to the eye, or grateful to the appetite. The lizards, properly so called, are beautifully painted and mottled; their frolicsome agility is amusing to those who are familiar with their appearance; and the great affection which some of them show to man, should, in some measure, be repaid with kindness. Others, such as the Iguana, though not possessed of beauty, are very serviceable, furnishing one of the most luxurious feasts the tropical climates can boast of. Those treated of before were objects of curiosity, because they were apparently objects of danger; most of these here mentioned have either use or beauty to engage us.

Directly descending from the crocodile, we find the Cordyle, the Tockay, and the Tejuguacu, all growing less in order, as I have named them. These fill up the chasm to be found between the crocodile and the African iguana.

The Iguana, which deserves our notice, is about five feet long, and the body about as thick as one's thigh; the skin is covered with

* Phil. Trans. ann. 1661, N. 21. art. 7.

small scales, like those of a serpent; and the back is furnished with a row of prickles, that stand up like the teeth of a saw; the eyes seem to be but half opened, except when the animal is angry, and then they appear large and sparkling; both the jaws are full of very sharp teeth, and the bite is dangerous, though not venomous, for it never lets loose till it is killed. The male has a skin hanging under his throat, which reaches down to his breast; and when displeased he puffs it up like a bladder: he is one-third larger and stronger than the female, though the strength of either avails them little towards their defence. The males are ash-coloured, and the females are green.

The flesh of these may be considered as the greatest delicacy of Africa and America; and the sportsmen of those climates go out to hunt the iguana as we do in pursuit of the pheasant or the hare. In the beginning of the season, when the great floods of the tropical climates are past away, and vegetation starts into universal verdure, the sportsmen are seen with a noose and a stick wandering along the sides of the rivers to take the iguana. This animal, though apparently formed for combat, is the most harmless creature of all the forest; it lives among the trees, or sports in the water, without ever offering to offend: there, having fed upon the flowers of the mahot, and the leaves of the mapou, that grow along the banks of the stream, it goes to repose upon the branches of the trees that hang over the water. Upon land the animal is swift of foot; but when once in possession of a tree, it seems conscious of the security of its situation, and never offers to stir. There the sportsman easily finds it, and as easily fastens his noose round its neck: if the head be placed in such a manner that the noose cannot readily be fastened, by hitting the animal a blow on the nose with the stick, it lifts the head, and offers it in some degree to the noose. In this manner, and also by the tail, the iguana is dragged from the trees, and killed by repeated blows on the head.

The Cameleon is a very different animal; and as the iguana satisfies the appetites of the epicure, this is rather the feast of the philosopher. Like the crocodile, this animal proceeds from an egg, and it also nearly resembles that formidable creature in form; but it differs widely in its size and its appetites, being not above eleven inches long, and delighting to sit upon trees, being afraid of serpents, from which it is unable to escape on the ground.

The head of a large cameleon is almost two inches long, and from thence to the beginning of the tail four and a half; the tail is five inches long, and the feet two and a half; the thickness of the body is different at different times, for sometimes from the back to the belly it is two inches, and sometimes but one; for it can blow itself up and contract itself at pleasure. This swelling and contraction is not only of the back and belly, but of the legs and tail.

These different tumours do not proceed from a dilatation of the

breast in breathing, which rises and falls by turns, but are very irregular, and seem adopted merely from caprice. The cameleon is often seen, as it were, blown up for two hours together, and then it continues growing less and less insensibly, for the dilation is always more quick and visible than the contraction. In this last state the animal appears extremely lean, the spine of the back seems sharp, and all the ribs may be counted: likewise the tendons of the legs and arms may be seen very distinctly.

This method of puffing itself up is similar to that in pigeons, whose crops are sometimes greatly distended with air. The cameleon has a power of driving the air it breathes over every part of the body; however, it only gets between the skin and the muscles, for the muscles themselves are never swoln. The skin is very cold to the touch; and though the animal seems so lean, there is no feeling the beating of the heart. The surface of the skin is unequal, and has a grain not unlike shagreen, but very soft, because each eminence is as smooth as if it were polished. Some of these little protuberances are as large as a pin's head on the arms, legs, belly, and tail; but on the shoulders and head they are of an oval figure, and a little larger; those under the throat are ranged in the form of a chaplet, from the lower lip to the breast. The colour of all these eminences, when the cameleon is at rest in a shady place, is of a bluish-grey, and the space between is of a pale red and yellow.

But when the animal is removed into the sun, then comes the wonderful part of its history. At first it appears to suffer no change of colour, its greyish spots still continuing the same; but the whole surface soon seems to imbibe the rays of light, and the simple colouring of the body changes into a variety of beautiful hues. Wherever the light comes upon the body, it is of a tawny brown; but that part of the skin on which the sun does not shine, changes into several brighter colours, pale yellow, or vivid crimson, which forms spots of the size of half one's finger: some of these descend from the spine half way down the back, and others appear on the sides, arms, and tail. When the sun has done shining, the original grey colour returns by degrees, and covers all the body. Sometimes the animal becomes all over spotted with brown spots of a greenish cast. When it is wrapped up in a white linen cloth for two or three minutes, the natural colour becomes much lighter, but not quite white, as some authors have pretended: however, from hence it must not be concluded, that the cameleon assumes the colour of the objects which it approaches; this is entirely an error, and probably has taken its rise from the continual changes it appears to undergo.

Le Bruyn, in his Voyage to the Levant, has given us a very ample description of the cameleon. During his stay at Smyrna he bought several of this kind; and, to try how long they could live, kept four of them in a cage, permitting them at times to run

about the house. The fresh sea-breeze seemed to give them most spirits and vivacity; they opened their mouths to take it in: he never perceived that they eat any thing, except now and then a fly, which they took half an hour to swallow: he observed their colour often to change, three or four times successively, without being able to find out any cause for such alterations; their common colour he found to be grey, or rather a pale mouse colour; but its most frequent changes were into a beautiful green spotted with yellow: sometimes the animal was marked all over with dark brown, and this often changed into a lighter brown: some colours, however, it never assumed, and, contrary to what was said above, he found red to be among the number.

Though our traveller took the utmost care, he was unable to preserve any of them alive above five months, and many of them died in four. When the cameleon changes place, and attempts to descend from an eminence, it moves with the utmost precaution, advancing one leg very deliberately before the other, still securing itself by holding whatever it can grasp by the tail. It seldom opens its mouth, except for fresh air; and when that is supplied, discovers its satisfaction by its motions, and the frequent changes of its colour. The tongue is sometimes darted out after its prey, which is flies; and this is as long as the whole body.* The eyes are remarkably little, though they stand out of the head; they have a single eye-lid, like a cap with a hole in the middle, through which the sight of the eye appears, which is of a shining brown, and round it there is a little circle of a gold colour: but the most extraordinary part of their conformation is, that the animal often moves one eye when the other is entirely at rest; nay, sometimes one eye will seem to look directly forward, while the other looks backward; and one will look upward, while the other regards the earth.

To this class of lizards we may refer the Dragon, a most terrible animal, but most probably not of nature's formation. Of this death-dealing creature all people have read; and the most barbarous countries, to this day, paint it to the imagination in all its terrors, and fear to meet it in every forest. It is not enough that nature has furnished those countries with poisons of various malignity; with serpents forty feet long; with elephants, lions, and tigers: to make their situation really dangerous, the capricious imagination is set at work to call up new terrors; and scarcely a savage is found, that does not talk of winged serpents of immoderate length, flying away with the camel or the rhinoceros, or

[* The tongue of the cameleon, says Linnæus, resembles an earth-worm, and is enlarged and somewhat flattened at the end. From this member there continually oozes out a zery glutinous liquor, by means of which it catches such insects as come within its reach, and it is surprising to see with what quickness it retracts its tongue the instant it has arrested any prey.]

LIZARD AND ALIGATOR.

destroying mankind by a single glare.* Happily, however, such ravagers are no way found to exist at present; and the whole race of dragons is dwindled down to the Flying Lizard, a little harmless creature, that only preys upon insects, and even seems to embellish the forest with its beauty.

The Flying Lizard of Java perches upon fruit trees, and feeds upon flies, ants, butterflies, and other small insects. It is a very harmless creature, and does no mischief in any respect. Gentil, in his Voyage round the World, affirms that he has seen these lizards at the island of Java, in the East Indies. He observed they flew very swiftly from tree to tree; and having killed one, he could not but admire the skin, which was painted with several beautiful colours: it was a foot in length, and had four paws like the common lizard; but its head was flat, and had a small hole in the middle; the wings were very thin, and resembled those of a flying fish. About the neck were a sort of wattles, not unlike those of cocks, which gave it no disagreeable appearance. He intended to have preserved it, in order to bring it into Europe; but it was corrupted by the heat, before the close of the day: however, they have since been brought into England, and are now common enough in the cabinets of the curious.

The last animal of the lizard kind that I shall mention, is the Chalèidian Lizard of Aldrovandus, very improperly called the Seps by modern historians. This animal seems to make the shade that separates the lizard from the serpent race. It has four legs, like the lizard; but so short, as to be utterly unserviceable in walking: it has a long slender body, like the serpent; and it is said to have the serpent's malignity also. The fore-legs are very near the head, the hind-legs are placed far backward; but before and behind they seem rather useless encumbrances, than instruments serving to assist the animal in its motions, or in providing for its subsistence. These animals are found above three feet long, and thick in proportion, with a large head and pointed snout. The whole body is covered with scales, and the belly is white, mixed with blue. It has four crooked teeth; as also a pointed tail, which, however, can inflict no wound. Whether the teeth be similar to the viper's fangs, we are not told, though Volteranus says they are covered with a membrane; by which I am apt to think he means a venom-bag, which is found at the root of the teeth of all serpents that are poisonous. It is viviparous, fifteen young ones having been taken alive out of its belly. Upon the whole, it appears to bear a strong affinity to the viper; and, like that animal, its bite may be dangerous.

[* The Basilisk has a long cylindrical tail, a radiated fin on the back, and a crest on the head, inclining backwards. This animal, so dreadful to the imagination of the ancients, that they considered its very breath and aspect as fatal, we now know to be quite inoffensive, feeding entirely on insects. It is found in the East Indies and in South America.]

CHAPTER VIII.

OF SERPENTS IN GENERAL.

We now come to a tribe that not only their deformity, their venom, their ready malignity, but also our prejudices, and our very religion, have taught us to detest. The serpent has from the beginning been the enemy of man; and it has hitherto continued to terrify and annoy him, notwithstanding all the arts that have been practised to destroy it. Formidable in itself, it deters the invader from the pursuit; and from its figure capable of finding shelter in a little space, it is not easily discovered by those who would venture to try the encounter. Thus possessed at once of potent arms and inaccessible or secure retreats, it baffles all the arts of man, though never so earnestly bent upon its destruction.

For this reason, there is scarcely a country in the world that does not still give birth to this poisonous brood, that seem formed to quell human pride, and repress the boasts of security. Mankind have driven the lion, the tiger, and the wolf from their vicinity; but the snake and the viper still defy their power, and frequently punish their insolence.

Their numbers, however, are thinned by human assiduity; and it is possible some of the kinds are wholly destroyed. In none of the countries of Europe are they sufficiently numerous to be truly terrible: the philosopher can meditate in the fields without danger, and the lover seek the grove without fearing any wounds but those of metaphor. The various malignity that has been ascribed to European serpents of old, is now utterly unknown; there are not above three or four kinds that are dangerous, and their poison operates in all in the same manner. A burning pain in the part, easily removable by timely applications, is the worst effect that we experience from the bite of the most venomous serpents of Europe. The drowsy death, the starting of the blood from every pore, the insatiable and burning thirst, the melting down the solid mass of the whole form into one heap of putrefaction,—these are horrors with which we are entirely unacquainted.

But though we have thus reduced these dangers, having been incapable of wholly removing them, in other parts of the world they still rage with all their ancient malignity. Nature seems to have placed them as sentinels to deter mankind from spreading too widely, and from seeking new abodes till they have thoroughly cultivated those at home. In the warm countries that lie within the tropic, as well as in the cold regions of the north, where the inhabitants are few, the serpents propagate in equal proportion. But of all countries those regions have them in the greatest abundance where the fields are unpeopled and fertile, and where the climate supplies warmth and humidity. All along the swampy banks of the river Niger or Oroonoko, where the sun is hot, the

forests thick, and the men but few, the serpents cling among the branches of the trees in infinite numbers, and carry on an unceasing war against all other animals in their vicinity. Travellers have assured us that they have often seen large snakes twining round the trunk of a tall tree, encompassing it like a wreath, and thus rising and descending at pleasure. In these countries, therefore, the serpent is too formidable to become an object of curiosity, for it excites much more violent sensation.

We are not therefore to reject, as wholly fabulous, the accounts left us by the ancients of the terrible devastations committed by a single serpent. It is probable, in early times, when the arts were little known, and mankind were but thinly scattered over the earth, that serpents, continuing undisturbed possessors of the forest, grew to an amazing magnitude, and every other tribe of animals fell before them. It then might have happened, that serpents reigned the tyrants of a district for centuries together. To animals of this kind, grown by time and rapacity to a hundred or a hundred and fifty feet in length, the lion, the tiger, and even the elephant itself, were but feeble opponents. The dreadful monster spread desolation round him; every creature that had life was devoured, or fled to a distance. That horrible *fætor*, which even the commonest and the most harmless snakes are still found to diffuse, might, in these larger ones, become too powerful for any living being to withstand; and while they preyed without distinction, they might thus also have poisoned the atmosphere around them. In this manner, having for ages lived in the hidden and unpeopled forest, and finding, as their appetites were more powerful, the quantity of their prey decreasing, it is possible they might venture boldly from their retreats, into the more cultivated parts of the country, and carry consternation among mankind, as they had before desolation among the lower ranks of nature. We have many histories of antiquity presenting us such a picture, and exhibiting a whole nation sinking under the ravages of a single serpent. At that time, man had not learned the arts of uniting the efforts of many, to effect one great purpose. Opposing multitudes only added new victims to the general calamity, and increased mutual embarrassment and terror. The animal was therefore to be singly opposed by him who had the greatest strength, the best armour, and the most undaunted courage. In such an encounter hundreds must have fallen, till one more lucky than the rest, by a fortunate blow, or by taking the monster in its torpid interval, and surcharged with spoil, might kill, and thus rid his country of the destroyer. Such was the original occupation of heroes; and those who first obtained that name, from their destroying the ravagers of the earth, gained it much more deservedly than their successors, who acquired their reputation only for their skill in destroying each other. But as we descend into more enlightened antiquity, we find these animals less formidable, as being attacked in a more successful manner. We are told, that while Regulus led his army along the banks of

the river Bagrada in Africa, an enormous serpent disputed his passage over. We are assured by Pliny, who says that he himself saw the skin, that it was a hundred and twenty feet long, and that it had destroyed many of the army. At last, however, the battering engines were brought out against it; and these assailing it at a distance it was soon destroyed. Its spoils were carried to Rome, and the general was decreed an ovation for his success. There are, perhaps, few facts better ascertained in history than this: an ovation was a remarkable honour, and was given only for some signal exploit, that did not deserve a triumph. No historian would offer to invent that part of the story at least, without being subject to the most shameful detection. The skin was kept for several years after in the capitol, and Pliny says he saw it there: now, though Pliny was a credulous writer, he was by no means a *false* one; and whatever he says he has seen, we may very safely rely on. At present, indeed, such ravages from serpents are scarce seen in any part of the world; not but that, in Africa and America, some of them are powerful enough to brave the assaults of men to this day.

But happily for us, we are placed at such a distance as to take a view of this tribe, without fearing for our safety; we can survey their impotent malignity with the same delight with which the poet describes the terrors of a dead monster.

Nequeant expleri corda tuendo
Terribiles oculos villosaque setis pictore.

To us, their slender form, their undulating motion, their vivid colouring, their horrid stench, their forky tongue, and their envenomed fangs, are totally harmless; and in this country their uses even serve to counterbalance the mischief they sometimes occasion.

If we take a survey of serpents in general, they have marks by which they are distinguished from all the rest of animated nature. They have the length and the suppleness of the eel, but want fins to swim with; they have the scaly covering and pointed tail of the lizard, but they want legs to walk with; they have the crawling motion of the worm, but, unlike that animal, they have lungs to breathe with: like all the reptile kind, they are resentful when offended; and nature has supplied them with terrible arms to revenge every injury.

Though they are possessed of very different degrees of malignity, yet they are all formidable to man, and have a strong similitude of form to each other; and it will be proper to mark the general characters before we descend to particulars. With respect to their conformation, all serpents have a very wide mouth, in proportion to the size of the head; and what is very extraordinary, they can gape and swallow the head of another animal which is three times as big as their own. I have seen a toad taken out of the belly of a snake, at Lord Spencer's, near London, the body of which was thrice the diameter of the animal that swallowed it. However, it is

no way surprising that the skin of the snake should stretch to receive so large a morsel; the wonder seems how the jaws could take it in. To explain this, it must be observed, that the jaws of this animal do not open as ours, in the manner of a pair of hinges, where bones are applied to bones, and play upon one another; on the contrary, the serpent's jaws are held together at the roots by a stretching muscular skin; by which means they open as widely as the animal chooses to stretch them, and admit of a prey much thicker than the snake's own body. The throat, like stretching leather, dilates to admit the morsel; the stomach receives it in part; and the rest remains in the gullet, till putrefaction and the juices of the serpent's body unite to dissolve it.

As to the teeth, I will talk more of them when I come to treat of the viper's poison: it will be sufficient here to observe, that some serpents have fangs, or canine teeth, and others are without them. The teeth in all are crooked and hollow, and, by a peculiar contrivance are capable of being erected or depressed at pleasure.

The eyes of all serpents are small, if compared to the length of the body; and though differently coloured in different kinds, yet the appearance of all is malign and heavy; and from their known qualities, they strike the imagination with the idea of a creature meditating mischief. In some, the upper eye-lid is wanting, and the serpent winks only with that below; in others, the animal has a nictitating membrane or skin, resembling that which is found in birds, which keeps the eye clean, and preserves the sight. The substance of the eye in all is hard and horny, the crystalline humour occupying a great part of the globe.

The holes for hearing are very visible in all, but there are no conduits for smelling, though it is probable that some of them enjoy that sense in tolerable perfection.

The tongue in all these animals is long and forky. It is composed of two long fleshy substances, which terminate in sharp points, and are very pliable. At the root it is connected very strongly to the neck by two tendons, that give it a variety of play. Some of the viper kind have tongues a fifth part of the length of their bodies; they are continually darting them out, but they are entirely harmless, and only terrify those who are ignorant of the real situation of their poison.

If from the jaws we go on to the gullet, we shall find it very wide for the animal's size, and capable of being distended to a great degree; at the bottom of this lies the stomach, which is not so capacious, and receives only a part of the prey, while the rest continues in the gullet for digestion. When the substance in the stomach is dissolved into chyle, it passes into the intestines, and from thence goes to nourishment, or to be excluded by the vent.

Like most other animals, serpents are furnished with lungs, which I suppose are serviceable in breathing, though we cannot perceive the manner in which this operation is performed; for

though serpents are often seen apparently to draw in their breath, yet we cannot find the smallest signs of their ever respiring it again. Their lungs, however, are long and large, and doubtless are necessary to promote their languid circulation. The heart is formed as in the tortoise, the frog, and the lizard kinds, so as to work without the assistance of the lungs. It is single, the greatest part of the blood flowing from the great vein to the great artery by the shortest course. By this contrivance of nature we easily gather two consequences; that snakes are amphibious, being equally capable of living on land and in the water; and that also they are torpid in winter like the bat, the lizard, and other animals formed in the same manner.

The vent in these animals serves for the emission of the urine and the fæces, and for the purposes of generation. The instrument of generation in the male is double, being forked like the tongue; the ovaries in the female are double also; and the aperture is very large, in order to receive the double instrument of the male. They copulate in their retreats; and it is said by the ancients, that in this situation they appear like one serpent with two heads: but how far this remark is founded in truth, I do not find any of the moderns that can resolve me.

As the body of this animal is long, slender, and capable of bending in every direction, the number of joints in the back-bone are numerous beyond what one would imagine. In the generality of quadrupeds, they amount to not above thirty or forty; in the serpent kind they amount to a hundred and forty-five from the head to the vent, and twenty-five more from that to the tail.* The number of these joints must give the back-bone a surprising degree of pliancy; but this is still increased by the manner in which each of these joints are locked into the other. In man and quadrupeds, the flat surfaces of the bones are laid one against the other, and bound tight by sinews; but in serpents the bones play one within the other, like ball and socket, so that they have full motion upon each other in every direction.† Thus if a man were to form a machine composed of so many joints as are found in the back of a serpent, he would find it no easy matter to give it such strength and pliancy at the same time. The chain of a watch is but a bungling piece of workmanship in comparison.

Though the number of joints in the back-bone is great, yet that of the ribs is still greater; for, from the head to the vent, there are two ribs to every joint, which makes their number two hundred and ninety in all. These ribs are furnished with muscles, four in number, which being inserted into the head, run along to the end of the tail, and give the animal great strength and agility in all its motions.

The skin also contributes to its motions, being composed of a number of scales, united to each other by a transparent membrane,

* Vide Charat. Anatom. † Derham, p. 306.

which grows harder as it grows older, until the animal changes, which is generally done twice a-year. This cover then bursts near the head, and the serpent creeps from it, by an undulatory motion, in a new skin much more vivid than the former. If the older slough be then viewed, every scale will be distinctly seen, like a piece of net-work, and will be found greatest where the part of the body they covered was largest.

There is much geometrical neatness in the disposal of the serpent's scales for assisting the animal's sinuous motion. As the edges of the foremost scales lie over the ends of their following scales, so those edges, when the scales are erected, which the animal has a power of doing in a small degree, catch in the ground like the wheels of a chariot, and so promote and facilitate the animal's progressive motion. The erecting these scales is by means of a multitude of distinct muscles, with which each is supplied, and one end of which is tacked each to the middle of the foregoing.

In some of the serpent kind there is the exactest symmetry in these scales, in others they are disposed more irregularly. In some there are larger scales on the belly, and often answering to the number of ribs; in others, however, the animal is without them. Upon this slight difference Linnæus has founded his distinctions of the various classes of the serpent tribe. Human curiosity, however, and even human interest, seem to plead for a very different method of distribution. It is not the number of scales on a formidable animal's belly, nor their magnitude or variety, that any way excite our concern. The first question that every man will naturally ask when he hears of a snake is, whether it be large? the second, whether it be venomous? In other words, the strongest lines in the animal's history are those that first excite our attention; and these it is every historian's business to display.

When we come to compare serpents with each other, the first great distinction appears in their size, no other tribe of animals differing so widely in this particular. What, for instance, can be so remotely separated as the Great Liboya of Surinam, that grows to thirty-six feet long, and the Little Serpent at the Cape of Good Hope and the north of the river Senegal, that is not above three inches, and covers whole sandy deserts with its multitudes? This tribe of animals, like that of fishes, seems to have no bounds put to their growth: their bones are in a great measure cartilaginous, and they are consequently capable of great extension; the older, therefore, a serpent becomes, the larger it grows; and as they seem to live to a great age, they arrive at an enormous size.

Leguat assures us that he saw one in Java that was fifty feet long. Carli mentions their growing to above forty feet; and we have now the skin of one in the Museum that measures thirty-two. Mr. Wentworth, who had large concerns in the Berbices in America, assures me, that in that country they grow to an enormous length. He one day sent out a soldier with an Indian to kill wild fowl for the table, and they accordingly went some miles from the fort: in

pursuing their game, the Indian, who generally marched before, beginning to tire, went to rest himself upon the fallen trunk of a tree, as he supposed it to be; but when he was just going to sit down, the enormous monster began to move, and the poor savage perceiving that he had approached a Liboya, the greatest of all the serpent kind, dropped down in an agony. The soldier, who perceived at some distance what had happened, levelled at the serpent's head, and by a lucky aim shot it dead: however, he continued his fire until he was assured that the animal was killed; and then going up to rescue his companion, who was fallen motionless by its side, he, to his astonishment, found him dead likewise, being killed by the fright. Upon his return to the fort, and telling what had happened, Mr. Wentworth ordered the animal to be brought up, when it was measured, and found to be thirty-six feet long. He had the skin stuffed, and then sent to Europe as a present to the Prince of Orange, in whose cabinet it is now to be seen at the Hague; but the skin has shrunk by drying two or three feet.

In the East Indies they grow also to an enormous size, particularly in the Island of Java, where we are assured that one of them will destroy and devour a buffalo. In a letter printed in the German Ephemerides, we have an account of a combat between an enormous serpent and a buffalo, by a person who assures us that he was himself a spectator. The serpent had for some time been waiting near the brink of a pool in expectation of its prey, when a buffalo was the first that offered. Having darted upon the affrighted animal, it instantly began to wrap it round with its voluminous twistings, and at every twist the bones of the buffalo were heard to crack almost as loud as the report of a cannon. It was in vain that the poor animal struggled and bellowed, its enormous enemy entwisted it too closely to get free; till at length, all its bones being mashed to pieces, like those of a malefactor on the wheel, and the whole body reduced to one uniform mass, the serpent untwined its folds to swallow its prey at leisure. To prepare for this, and in order to make the body slip down the throat more glibly, it was seen to lick the whole body over, and thus cover it with its mucus. It then began to swallow it at that end that offered least resistance, while its length of body was dilated to receive its prey, and thus took in at once a morsel that was three times its own thickness. We are assured by travellers, that these animals are often found with the body of a stag in their gullet, while the horns, which they are unable to swallow, keep sticking out at their mouth.

But it is happy for mankind that the rapacity of these frightful creatures is often their punishment; for whenever any of the serpent kind have gorged themselves in this manner, whenever their body is seen particularly distended with food, they then become torpid, and may be approached and destroyed with safety. Patient of hunger to a surprising degree, whenever they seize and swallow their prey, they seem like surfeited gluttons, unwieldy, stupid, helpless, and sleepy: they at that time seek some retreat, where

they may lurk for several days together, and digest their meal in safety: the smallest effort at that time is capable of destroying them; they can scarcely make any resistance, and they are equally unqualified for fight or opposition. That is the happy opportunity of attacking them with success: at that time the naked Indian himself does not fear to assail them. But it is otherwise when this sleepy interval of digestion is over; they then issue with famished appetites from their retreats, and with accumulated terrors, while every animal of the forest flies before them.

Carli describes the Long Serpent of Congo making its track through the tall grass, like mowers in a summer's day. He could not without terror behold whole lines of grass lying levelled under the sweep of its tail. In this manner it moved forward with great rapidity, until it found a proper situation frequented by its prey: there it continued to lurk in patient expectation, and would have remained for weeks together, had it not been disturbed by the natives.

Other creatures have a choice in their provision, but the serpent indiscriminately preys upon all, the buffalo, the tiger, and the gazelle. One would think the porcupine's quills might be sufficient to protect it; but whatever has life, serves to appease the hunger of these devouring creatures; porcupines, with all their quills, have frequently been found in their stomachs when killed and opened; nay, they most frequently are seen to devour each other.

A life of savage hostility in the forest, offers the imagination one of the most tremendous pictures in nature. In those burning countries where the sun dries up every brook for hundreds of miles round, when what had the appearance of a great river in the rainy season, becomes in summer one dreary bed of sand; in those countries, I say, a lake that is never dry, or a brook that is perennial, is considered by every animal as the greatest convenience of nature. As to food, the luxuriant landscape supplies that in sufficient abundance; it is the want of water that all animals endeavour to remove, and, inwardly parched by the heat of the climate, traverse whole deserts to find out a spring. When they have discovered this, no dangers can deter them from attempting to slake their thirst. Thus the neighbourhood of a rivulet in the heart of the tropical continents, is generally the place where all the hostile tribes of nature draw up for the engagement. On the banks of this little envied spot, thousands of animals of various kinds are seen venturing to quench their thirst, or preparing to seize their prey. The elephants are perceived in a long line, marching from the darker parts of the forest; the buffaloes are there, depending upon numbers for security; the gazelles, relying solely upon their swiftness; the lion and tiger waiting a proper opportunity to seize; but chiefly the larger serpents are upon guard there, and defend the accesses of the lake. Not an hour passes without some dreadful combat; but the serpent defended by its

scales, and naturally capable of sustaining a multitude of wounds, is, of all others, the most formidable. It is the most wakeful also; for the whole tribe sleep with their eyes open, and are consequently for ever upon the watch: so that, till their rapacity is satisfied, few other animals will venture to approach their station.

But though these animals are, of all others, the most voracious, and though the morsel which they swallow, without chewing, is greater than what any other creature, either by land or water, the whale itself not excepted, can devour, yet no animals upon earth bear abstinence so long as they. A single meal, with many of the snake kind, seems to be the adventure of a season; it is an occurrence of which they have been for weeks, nay sometimes for months, in patient expectation. When they have seized their prey, their industry for several weeks is entirely discontinued; the fortunate capture of an hour often satisfies them for the remaining period of their annual activity. As their blood is colder than that of most other terrestrial animals, and as it circulates but slowly through their bodies, so their powers of digestion are but feeble. Their prey continues, for a long time, partly in the stomach, partly in the gullet, and a part is often seen hanging out of the mouth. In this manner it digests by degrees; and in proportion as the part below is dissolved, the part above is taken in. It is not therefore till this tedious operation is entirely performed, that the serpent renews its appetite and its activity. But should any accident prevent it from issuing once more from its cell, it still can continue to bear famine for weeks, months, nay for years together. Vipers are often kept in boxes for six or eight months without any food whatever; and there are little serpents sometimes sent over to Europe from Grand Cairo, the name of which I have not been able to learn, that live for several years in glasses, and never eat at all, nor even stain the glass with their excrements. Thus the serpent tribe unite in themselves two very opposite qualities,—wonderful abstinence, and yet incredible rapacity.

If, leaving the consideration of their appetites, we come to compare serpents as to their voices, some are found silent, some have a peculiar cry, but hissing is the sound which they most commonly send forth, either as a call to their kind, or as a threat to their enemies. In the countries where they abound, they are generally silent in the middle of the day, when they are obliged to retire from the heat of the climate; but as the cool of the evening approaches, they are then heard issuing from their cells, with continued hissings; and such is the variety of their notes, that some have assured me they very much resemble the music of an English grove. This some will hardly credit: at any rate, such notes, however pleasing, can give but very little delight, when we call to mind the malignity of the minstrel. If considered, indeed, as they answer the animal's own occasions, they will be found well adapted to its nature, and fully answering the purposes of terrifying such as would venture to offend it.

With respect to motion, some serpents, particularly those of the

viper kind, move slowly, while others, such as the Ammodytes, dart with amazing swiftness. The motion in all is similar; but the strength of body in some gives a very different appearance. The viper, that is but a slow feeble-bodied animal, makes way in a heavy undulating manner, advancing its head, then drawing up its tail behind, and bending the body into a bow; then from the spot where the head and tail were united, advancing the head forward as before. This, which is the motion of all serpents, is very different from that of the earth-worm, or the naked snail. The serpent, as was said above, has a back-bone, with numerous joints; and this bone the animal has the power of bending in every direction, but without being able to shorten or lengthen it at pleasure. The earth-worm, on the other hand, has no back-bone; but its body is composed of rings, which, like a barber's puff, it can lengthen or shorten as it finds necessary. The earth-worm, therefore, in order to move forward, lengthens the body; then, by the fore-part clings to the ground where it has reached, and then contracts and brings up its rear; then when the body is thus shortened, the fore-part is lenghtened again for another progression; and so on. The serpent, instead of shortening the body, bends it into an arch; and this is the principal difference between serpentine and vermicular progression.

I have instanced this motion in the viper, as most easily discerned; but there are many serpents that dart with such amazing swiftness, that they appear rather to leap than crawl. It is most probable, however, that no serpent can dart upon even ground further than its own length at one effort. Our fears, indeed, may increase the force of their speed, which is sometimes found so fatal. We are told by some, that they will dart to a very great distance; but this my inquiries have never been able to ascertain. The manner of progression in the swiftest serpent we know, which is the Jaculus, is by instantly coiling itself upon its tail, and darting from thence to its full extent; then carrying the tail as quick as lightning to the head, coiling and darting again; and by this means proceeding with extreme rapidity, without ever quitting the ground. Indeed, if we consider the length and the weakness of the back-bone in all these animals; if we regard the make of their vertebræ, in which we shall find the junctures all formed to give play, and none to give power, we cannot be of opinion that they have a faculty of springing from the ground, as they entirely want a *fulcrum*, if I may so express it, from whence to take their spring; the whole body being composed of unsupported muscles and joints that are yielding. It must be confessed, that they dart down from trees upon their prey; but their weight alone is sufficient for that purpose, without much effort of their own.

Though all serpents are amphibious, some are much fonder of the water than others; and though destitute of fins or gills, remain at the bottom, or swim along the surface with great ease. From their internal structure, just sketched above, we see how well

adapted they are for either element, and how capable their blood is of circulating at the bottom, as freely as the frog or the tortoise. They can, however, endure to live in fresh water only; for salt is an effectual bane to the whole tribe. The greatest serpents are most usually found in fresh water, either choosing it as their favourite element, or finding their prey in such places in the greatest abundance. But that all will live and swim in liquids, appears from the experiment of Redi, who put a serpent into a large glass vessel of wine, where it lived swimming about six hours; though, when it was by force immersed and kept under that liquid, it lived only one hour and a half. He put another in common water, where it lived three days; but when it was kept under water, it lived only about twelve hours.* Their motion there, however, is perfectly the reverse of what it is upon land; for, in order to support themselves upon an element lighter than their bodies, they are obliged to increase their surface in a very artificial manner. On earth their windings are perpendicular to the surface; in water they are parallel to it: in other words, if I should wave my hand up and down, it will give an idea of the animal's progress on land: if I should wave it to the right and left, it will give some idea of its progress on the water.

Some serpents have a most horrible fœtor attending them, which is alone capable of intimidating the brave. This proceeds from two glands near the vent, like those in the weasel or pole-cat; and, like those animals, in proportion as they are excited by rage or by fear, the scent grows stronger. It would seem, however, that such serpents as are most venomous, are least offensive in this particular; since the rattle-snake and the viper have no smell whatever: nay, we are told, that at Calecut and Cranganon, in the East Indies, there are some very noxious serpents, who are so far from being disagreeable, that their excrements are sought after, and kept as the most pleasing perfume. The Æsculapian Serpent is also of this number.

Some serpents bring forth their young alive, as the viper; some bring forth eggs, which are hatched by the heat of their situation, as the common Black Snake, and the majority of the serpent tribe. When a reader, ignorant of anatomy, is told that some of those animals produce their young alive, and that some produce eggs only, he is apt to suppose a very great difference in the internal conformation, which makes such a variety in the manner of bringing forth. But this is not the case: these animals are internally alike, in whatever manner they produce their young; and the variety in their bringing forth, is rather a slight than a real discrimination. The only difference is, that the viper hatches her eggs, and brings them to maturity within her body; the snake is more premature in her productions, and sends her eggs into the light some time before the young ones are capable of

* Redi, Exper. p. 170.

leaving the shell. Thus, if either are opened, the eggs will be found in the womb, covered with their membranous shell, and adhering to each other, like large beads on a string. In the eggs of both, young ones will be found, though at different stages of maturity: those of the viper will crawl and bite the moment the shell that encloses them is broke open; those of the snake are not yet arrived at their perfect form.

Father Labat took a serpent of the viper kind, that was nine feet long, and ordered it to be opened in his presence. He then saw the manner in which the eggs of these animals lie in the womb. In this creature there were six eggs, each of the size of a goose-egg, but longer, more pointed, and covered with a membranous skin, by which also they were united to each other. Each of these eggs contained from thirteen to fifteen young ones, about six inches long, and as thick as a goose-quill. Though the female from whence they were taken was spotted, the young seemed to have a variety of colours, very different from the parent; and this led the traveller to suppose that the colour was no characteristic mark among serpents. These little mischievous animals were no sooner let loose from the shell, than they crept about, and put themselves into a threatening posture, coiling themselves up, and biting the stick with which he was destroying them. In this manner he killed seventy-four young ones; those that were contained in one of the eggs escaped at the place where the female was killed, by the bursting of an egg, and their getting among the bushes.

The last distinction that I shall mention, but the most material among serpents, is, that some are venomous and some inoffensive. If we consider the poison of serpents as it relates to man, there is no doubt but that it is a scourge and an affliction. The various calamities that the poison of serpents is capable of producing, are not only inflicted by the animal itself, but by men, more mischievous than even serpents, who prepare their venom to destroy each other. With this the savages poison their arms, and also prepare their revengeful potions. The ancients were known to preserve it for the purposes of suicide; and even among semi-barbarous countries at this day, the venom of snakes is used as a philtre.

But, though the poison be justly terrible to us, it has been given to very good purposes for the animal's own proper support and defence. Without this, serpents, of all other animals, would be the most exposed and defenceless;—without feet for escaping a pursuit; without teeth capable of inflicting a dangerous wound, or without strength for resistance: incapable, from their size, of finding security in very small retreats, like the earth-worm, and disgusting all from their deformity, nothing was left for them but a speedy extirpation. But furnished as they are with powerful poison, every rank of animals approach them with dread, and never seize them but at advantage. Nor is this all the advantage

they derive from it. The malignity of a few serves for the protection of all. Though not above a tenth of their number are actually venomous, yet the similitude they all bear to each other excites a general terror of the whole tribe; and the uncertainty of their enemies in which the poison chiefly resides, makes even the most harmless formidable. Thus Providence seems to have acted with double precaution; it has given some of them poison for the general defence of a tribe naturally feeble; but it has thinned the numbers of those which are venomous, lest they should become too powerful for the rest of animated nature.

From these noxious qualities in the serpent kind, it is no wonder that not only man, but beasts and birds, carry on an unceasing war against them. The ichneumon of the Indians, and the peccary of America, destroy them in great numbers. These animals have the art of seizing them near the head; and it is said that they can skin them with great dexterity. The vulture and the eagle also prey upon them in great abundance; and often sousing down from the clouds, drop upon a long serpent, which they snatch up struggling and writhing in the air. Dogs also are bred up to oppose them. Father Feuillée tells us, that being in the woods of Martinico, he was attacked by a large serpent, which he could not easily avoid, when his dog immediately came to his relief, and seized the assailant with great courage. The serpent entwined him, and pressed him so violently that the blood came out of his mouth, and yet the dog never ceased till he had tore it to pieces. The dog was not sensible of his wounds during the fight; but, soon after, his head swelled prodigiously, and he lay on the ground as dead. But his master having found hard by a banana tree, he applied the juice, mixed with treacle, to the wounds, which recovered the dog, and quickly healed his sores.

But it is in man that these venomous creatures find the most dangerous enemy. The Psylli of old were famous for charming and destroying serpents. Some moderns pretend to the same art. Casaubon says, that he knew a man who could at any time summon a hundred serpents together, and draw them into the fire. Upon a certain occasion, when one of them bigger than the rest would not be brought in, he only repeated his charm, and it came forward, like the rest, to submit to the flames. Philostratus describes particularly how the Indians charm serpents. "They take a scarlet robe embroidered with gold letters, and spread it before a serpent's hole. The golden letters have a fascinating power; and, by looking steadfastly, the serpent's eyes are overcome and laid asleep." These and many other feats have been often practised upon these animals by artful men, who had first prepared the serpents for their exercise, and then exhibited them as adventitiously assembled at their call. In India there is nothing so common as dancing serpents, which are carried about in a broad flat vessel, somewhat resembling a sieve. These erect and put themselves in motion at the word of command. When their keeper

sings a slow tune, they seem by their heads to keep time; when he sings a quicker measure, they appear to move more brisk and lively. All animals have a certain degree of docility; and we find that serpents themselves can be brought to move and approach at the voice of their master. From this trick successfully practised before the ignorant, it is most probable has arisen all the boasted pretensions which some have made to charming of serpents; an art to which the native Americans pretend at this very day. One of Linnæus's pupils, we are told, purchased the secret from an Indian, and then discovered it to his master; but, like all secrets of the kind, it is probable this ended in a few unmeaning words of no efficacy.

Though the generality of mankind regard this formidable race with horror, yet there have been some nations, and there are some at this day, that consider them with veneration and regard. The adoration paid by the ancient Egyptians to a serpent is well known; many of the nations at present along the western coast of Africa retain the same unaccountable veneration. Upon the Gold and Slave Coasts, a stranger, upon entering the cottages of the natives, is often surprised to see the roof swarming with serpents, that cling there without molesting, and unmolested by the natives. But his surprise will increase upon going farther southward to the kingdom of Widah, when he finds that a serpent is the god of the country. This animal, which travellers describe as a huge overgrown creature, has its habitation, its temple, and its priests. These impress the vulgar with an opinion of its virtues; and numbers are daily seen to offer, not only their goods, their provisions, and their prayers, at the shrine of their hideous deity, but also their wives and daughters. These the priests readily accept of, and after some days of penance, return them to their suppliants, much benefitted by the serpent's supposed embraces. Such a complicated picture of ignorance and imposture gives no very favourable impressions of our fellow-creatures; but we may say, in defence of human nature, that the most frightful of reptiles is worshipped by the most uncultivated and barbarous of mankind.

From this general picture of the serpent tribe, one great distinction obviously presents itself; namely, into those that are venomous, and those that are wholly destitute of poison. To the first belong the Viper, the Rattle-Snake, the Cobra di Capello, and all the affinities; to the other, the Common Black Snake, the Lidoya, the Boiguacu, the Amphisbæna, and various others, that, though destitute of venom, do not cease to be formidable. I will therefore give their history separately, beginning with the venomous class, as they have the strongest claims to our notice and attention.

CHAPTER IX.

OF VENOMOUS SERPENTS IN GENERAL.

THE poison of serpents has been for ages one of the greatest objects of human consideration. To us who seldom feel the vengeful wound, it is merely a subject of curiosity; but to those placed in the midst of the serpent tribe, who are every day exposed to some new disaster, it becomes a matter of the most serious importance. To remedy the bite of a serpent is considered among our physicians as one of the slightest operations in medicine, but among the physicians of the East the antidotes for this calamity make up the bulk of their dispensaries. In our colder climates the venom does not appear with that instantaneous operation which it exhibits in the warmer regions; for either its powers are less exquisite, or our fluids are not carried round in such rapid circulation.

In all countries, however, the poison of the serpent is sufficiently formidable to deserve notice, and to excite our attention to its nature and effects. It will therefore, in the first place, be proper to describe its seat in the animal, as also the instrument by which the wound is made and the poison injected. In all this venomous class of reptiles, whether the viper, the rattle-snake, or the cobra di capello, there are two large teeth or fangs that issue from the upper jaw, and that hang out beyond the lower. The rest of the snake tribe are destitute of these, and it is most probable that wherever these fangs are wanting the animal is harmless; on the contrary, wherever they are found, it is to be avoided as the most pestilent enemy. These are the instruments that seem to place the true distinction between animals of the serpent kind: the wounds which these fangs inflict produce the most dangerous symptoms; the wounds inflicted by the teeth only are attended with nothing more than the ordinary consequences attending the bite of any other animal. Our first great attention, therefore, upon seeing a serpent, should be directed to the teeth. If it has the fang teeth, it is to be placed among the venomous class; if it wants them, it may be set down as inoffensive. I am not ignorant that many serpents are said to be dangerous whose jaws are unfurnished with fangs, but it is most probable that our terrors only have furnished these animals with venom; for of all the tribe whose teeth are thus formed, not one will be found to have a bag for containing poison, nor a conduit for injecting it into the wound. The Black Snake, the Liboya, the Blind Worm, and a hundred others that might be mentioned, have their teeth of an equal size, fixed into the jaws, and with no other apparatus for inflicting a dangerous wound than a dog or a lizard: but it is otherwise with the venomous tribe we are now describing; these are well furnished, not only with an ' 'oratory where the poison is formed, but a canal by which it is

conducted to the jaw, a bag under the tooth for keeping it ready for every occasion, and also an aperture in the tooth itself for injecting it into the wound. To be more particular, the glands that serve to fabricate this venomous fluid are situated on each side of the head behind the eyes, and have their canals leading from thence to the bottom of the fangs in the upper jaw, where they empty into a kind of bladder, from whence the fangs on each side are seen to grow. The venom contained in this bladder is a yellowish, thick, tasteless liquor, which injected into the blood is death, yet which may be swallowed without any danger.

The fangs that give the wound come next under observation: they are large in proportion to the size of the animal that bears them; crooked, yet sharp enough to inflict a ready wound. They grow on one side, and sometimes two, from two moveable bones in the upper jaw, which by sliding backward or forward have a power of erecting or depressing the teeth at pleasure. In these bones are also fixed many teeth, but no way venomous, and only serving to take and hold the animal's prey. Besides this apt disposition of the fangs, they are hollow within, and have an opening towards the point like the slit of a pen, through which, when the fang is pressed down upon the bladder where it grows, there is seen to issue a part of the venom that lay below. To describe this operation at once: when the serpent is irritated to give a venomous wound, it opens its formidable jaws to the widest extent; the moveable bones of the upper jaw slide forward; the fangs that lay before inclining are thus erected; they are struck with force into the flesh of the obnoxious person; by meeting resistance at the points, they press upon the bladders of venom from whence they grow; the venom issues up through the hollow of the tooth, and is pressed out through its slit into the wound, which by this time the tooth has made in the skin. Thus from a slight puncture, and the infusion of a drop of venom scarce larger than the head of a pin, the part is quickly inflamed, and, without a proper antidote, the whole frame contaminated.

The appearances which this venom produces are different, according to the serpent that wounds, or the season, or the strength of the animal that strikes the blow. If a viper inflicts the wound, and the remedy be neglected, the symptoms are not without danger. It first causes an acute pain in the place affected, attended with a swelling, first red, and afterwards livid. This by degrees spreads to the neighbouring parts; great faintness, and a quick, though low and interrupted pulse ensues: to this succeed great sickness at the stomach, bilious and convulsive vomitings, cold sweats, pains about the navel, and death itself. But the violence of the symptoms depends much on the season of the year, the difference of the climate, the size or age of the animal, and the depth and situation of the wound. These symptoms are much more violent, and succeed each other more rapidly after the bite of a rattle-snake; but when the person is bit by the cobra di capello, he dies in

an hour, his whole frame being dissolved into a putrid mass of corruption.

Nothing surely can more justly excite our wonder, than that so small a quantity of venom should produce such powerful and deadly effects. If the venom itself be examined through a microscope, it will be found to shoot into little crystals, that to an imagination already impressed with its potency, look like so many darts fit for entering the blood-vessels, and wounding their tender coats. But all these darts are wholly of our own making; the softest, mildest fluid whatever, possessed of any consistency, will form crystals under the eye of the microscope, and put on an appearance exactly like the venom of the viper. In fact, this venom has no acrid taste whatever; and to all experiments that our senses can make upon it, appears a slimy insipid fluid. Charas, who often tasted it, assures us of the fact; and asserts, that it may be taken inwardly without any sensible effects, or any prejudice to the constitution. But the famous experiments that were tried by Redi and others, in the presence of the Great Duke of Tuscany and his court, put this beyond any doubt whatsoever. By these it appeared, that the serpent having once bitten, exhausted for that time the greatest part of his poison; and though the wound caused by its biting a second time was attended with some malignant symptoms, yet they were much milder than before. It appeared that the serpent biting upon a sponge, or a piece of soft bread, and then biting a dog immediately after, did not inflict a wound more dangerous than the prick of a needle. It appeared that the venom being collected, and a needle dipped therein, this produced almost as painful effects as the teeth of the animal itself. But what caused the greatest surprise in the court was the seeming rashness of one Tozzi, a viper-catcher, who, while the philosophers were giving elaborate lectures on the danger of the poison when taken internally, boldly desired a large quantity of it might be put together; and then, with the utmost confidence, drank it off before them all. The court was struck with astonishment, and expected that the man would instantly fall dead; but they soon perceived their mistake, and found that, taken in this manner, the poison was as harmless as water; so true is that famous passage of Lucan,—

Noxia serpentum est admixto sanguine pestis:
Morsu virus habent, et fatum in dente minantur:
Poenla morte carent.

What then shall we say to the speedy effect of so seemingly harmless a liquid taken into the circulation? Let us first observe, that milk is one of the most mild and nourishing of all fluids, and seemingly the most friendly to the human constitution; yet if milk be injected into a vein, it will quickly become fatal, and kill with more certain destruction than even the venom of the viper. From

hence then we may infer, that the introducing not only the serpentine venom, but also a quantity of any other mixture, into the circulation, will be fatal; and that, consequently, serpents kill as well by their power of injecting the wound, as by the potency of their poison. Some indeed may inject a more acrimonious mixture, and this may produce more speedy effects; but any mixture thus injected would be dangerous, and many would be fatal.

Ray gives us an instance of the potency of the serpent poison, which, though it has all the air of a fable, I cannot help transcribing. "A gentleman who went over to the East Indies, while he was one day sitting among some friends, was accosted by an Indian juggler, who offered to show him some experiments respecting the venom of serpents; an exhibition usual enough in that country. Having first, therefore, produced a large serpent, he assured the company that it was harmless; and to convince them of what he said, he tied up his arm, as is usual with those who are going to be bled, and whipped the serpent till it was provoked to bite him. Having drawn in this manner about half a spoonful of blood from his arm, he put the congealed clot upon his thigh. He then took out a much smaller serpent, which was no other than the cobra di capello; and having tied up its neck, he procured about half a drop of its venom, which he sprinkled on the clot of blood on his thigh, which instantly began to ferment and bubble, and soon changed colour, from a red into a yellow."

This he pretended was caused by the extreme malignity of that animal's venom: however, I have no doubt that the whole is either a fable, or a trick of the Indian; who, while he seemed to mix the serpent's venom, actually infused some stronger ingredient, some mineral acid, into the mass of blood, which was capable of working such a change. It cannot be supposed that any animal poison could act so powerfully upon the blood already drawn and coagulated; for a poison that could operate thus instantaneously upon cold blood, could not fail of soon destroying the animal itself.

Be this as it will, the effects of serpent poison are too well known, though the manner of operation be not so clear. As none of this malignant tribe grow to a great size, the longest of them not exceeding nine feet, they seldom seek the combat with larger animals, or offend others till they are first offended. Did they exert their malignity in proportion to their power, they could easily drive the ranks of nature before them; but they seem unconscious of their own superiority, and rather fly than offer to meet the meanest opposer. Their food chiefly consists of small prey, such as birds, moles, toads, and lizards: so that they never attack the more formidable animals, that would seldom die unrevenged. They lurk therefore in the clefts of rocks, or among stony places; they twine round the branches of trees, or sun themselves in the long grass at the bottom. There they only seek repose and safety. If some unwary traveller invades their retreats, their first effort is to fly; but when either pursued or accidentally trod upon, they

then make a fierce and fatal resistance. For this purpose, they raise themselves according to their strength upon their tail, erect their head, seize the limb that presses them; the wound is given, and the head withdrawn in a moment. It is not therefore without reason that the Asiatics, who live in regions where serpents greatly abound, wear boots and long clothes, which very well protect their lower parts from the accidental resentment of their reptile annoyers.

In the Eastern and Western Indies, the number of noxious serpents is various; in this country we are acquainted with only one. The viper is the only animal in Great Britain from whose bite we have any thing to fear. In the tropical climates, the rattle-snake, the whip-snake, and the cobra di capello, are the most formidable, though by no means the most common. From the general notoriety of these serpents, and the universal terror which they occasion, it would seem that few others are possessed of such powerful malignity.

Vipers are found in many parts of this island; but the dry, stony, and particularly the chalky countries abound with them. This animal seldom grows to a greater length than two feet; though sometimes they are found above three. The ground colour of their bodies is a dirty yellow; that of the female is deeper. The back is marked the whole length with a series of rhomboid black spots, touching each other at the points; the sides with triangular ones, the belly entirely black. It is chiefly distinguished from the common black snake by the colour, which in the latter is more beautifully mottled, as well as by the head, which is thicker than the body; but particularly by the tail, which in the viper, though it ends in a point, does not run tapering to so great a length as in the other. When, therefore, other distinctions fail, the difference of the tail can be discerned at a single glance.

The viper differs from most other serpents in being much slower, as also in its excluding its young completely formed, and bringing them forth alive. The kindness of Providence seems exerted not only in diminishing the speed, but also the fertility of this dangerous creature. They copulate in May, and are supposed to be about three months before they bring forth, and have seldom above eleven eggs at a time. These are of the size of a blackbird's egg, and chained together in the womb like a string of beads. Each egg contains from one to four young ones; so that the whole of a brood may amount to about twenty or thirty. They continue in the womb till they come to such perfection as to be able to burst from the shell; and they are said by their own efforts to creep from confinement into the open air, where they continue for several days without taking any food whatsoever. "We have been often assured," says Mr. Pennant, "by intelligent people, of the truth of a fact, that the young of a viper when terrified will run down the throat of the parent, and seek shelter in its belly, in the same manner as the young of the opossum retire into the ventral pouch

of the old one. From this," continues he, "some have imagined that the viper is so unnatural as to devour its own young; but this deserves no credit, as these animals live upon frogs, toads, lizards, and young birds, which they often swallow whole, though the morsel is often three times as thick as their own body.

The viper is capable of supporting very long abstinence, it being known that some have been kept in a box six months without food; yet during the whole time they did not abate of their vivacity. They feed only a small part of the year, but never during their confinement; for if mice, their favourite diet, should at that time be thrown into their box, though they will kill, yet they will never eat them. When at liberty, they remain torpid throughout the winter; yet, when confined, have never been observed to take their annual repose. Their poison, however, decreases in proportion to the length of their confinement; and it is thought, that the virtues of the animal's flesh are by the same restraints considerably lessened.

They are usually taken with wooden tongs by the end of the tail, which may be done without danger; for, while held in that position, they are unable to wind themselves up to hurt their enemy: yet, notwithstanding this precaution, the viper-catchers are frequently bit by them; but by the application of olive oil, the bite is effectually cured.

One William Oliver, a viper-catcher at Bath, was the first who discovered this admirable remedy. On the first of June, 1735, in the presence of a great number of persons, he suffered himself to be bit by an old black viper, brought by one of the company, upon the wrist and joint of the thumb of the right hand, so that drops of blood came out of the wound: he immediately felt a violent pain, both at the top of his thumb, and up his arm, even before the viper was loosened from his hand; soon after he felt a pain, resembling that of burning, trickle up his arm; in a few minutes his eyes began to look red and fiery, and to water much; in less than an hour he perceived the venom seize his heart, with a pricking pain, which was attended with faintness, shortness of breath, and cold sweats; in a few minutes after this, his belly began to swell, with great gripings, and pains in his back, which were attended with vomitings and purgings: during the violence of these symptoms, his sight was gone for several minutes, but he could hear all the while. He said, that in his former experiments he had never deferred making use of his remedy longer than he perceived the effects of the venom reaching his heart; but this time, being willing to satisfy the company thoroughly, and trusting to the speedy effects of his remedy, which was nothing more than olive oil, he forbore to apply any thing till he found himself exceedingly ill, and quite giddy. About an hour and a quarter after the first of his being bit, a chafing-dish of glowing charcoal was brought in, and his naked arm was held over it, as near as he could bear, while his wife rubbed in the oil with her hand, turning his arm

continually round, as if she would have roasted it over the coals: he said the poison soon abated, but the swelling did not diminish much. Most violent purgings and vomitings soon ensued; and his pulse became so low, and so often interrupted, that it was thought proper to order him a repetition of cordial potions: he said he was not sensible of any great relief from these; but that a glass or two of olive oil drank down, seemed to give him ease. Continuing in this dangerous condition, he was put to bed, where his arm was again bathed over a pan of charcoal, and rubbed with olive oil, heated in a ladle over the charcoal, by Dr. Mortimer's direction, who was the physician that drew up the account. From this last operation, he declared that he found immediate ease, as though by some charm: he soon after fell into a profound sleep, and, after about nine hours sound rest, awaked about six the next morning, and found himself very well; but in the afternoon, on drinking some rum and strong beer, so as to be almost intoxicated, the swelling returned, with much pain and cold sweats, which abated soon on bathing the arm, as before, and wrapping in up in a brown paper soaked in the oil.

Such are the effects of the viper's bite; yet its flesh has long been celebrated as a noble medicine. A broth made by boiling one viper in a quart of water till it comes to a pint, is the usual method in which it is given at present; and it is said to be a very powerful restorative in battered constitutions: the salt of vipers is also thought to exceed any other animal salt whatever, in giving vigour to the languid circulation, and prompting to venery.

The Rattle-snake is bred in America, and in no part of the Old World. Some are as thick as a man's leg, and six feet in length; but the most usual size is from four to five feet long. In most particulars it resembles the viper: like that animal, having a large head and a small neck, being of a dusky colour, and furnished with fangs that inflict the most terrible wounds. It differs, however, in having a large scale, which hangs like a pent-house over each eye. The eye also is furnished with a nictitating membrane, that preserves it from dust; and its scales are of a considerable degree of hardness. They are of an orange, tawny, and blackish colour on the back; and of an ash colour on the belly, inclining to lead. The male may be readily distinguished from the female, by a black velvet spot on the head, and by the head being smaller and longer. But that which, besides their superior malignity, distinguishes them from all other animals, is their rattle, an instrument lodged in their tail, by which they make such a loud rattling noise, when they move, that their approach may readily be perceived, and the danger avoided. This rattle, which is placed in the tail, somewhat resembles, when taken out of the body, the curb chain of a bridle: it is composed of several thin, hard, hollow bones, linked to each other, and rattling upon the slightest motion. It is supposed by some, that the snake acquires an additional bone every year; and that, from hence, its age may be precisely known:

RATTLE SNAKE.

however this may be, certain it is, that the young snakes of a year or two old have no rattles at all; while many old ones have been killed that had from eleven to thirteen joints each. They shake and make a noise with these rattles with prodigious quickness when they are disturbed; however, the peccary and the vulture are no way terrified at the sound, but hasten, at the signal, to seize the snake, as their most favourite prey.

It is very different with almost every other animal. The certain death which ensues from this terrible creature's bite, makes a solitude wherever it is heard. It moves along with the most majestic rapidity; neither seeking to offend the larger animals, nor fearing their insults. If unprovoked, it never meddles with any thing but its natural prey; but when accidentally trod upon, or pursued to be destroyed, it then makes a dreadful and desperate defence. It erects itself upon its tail, throws back the head, and inflicts its wound in a moment; then parts, and inflicts a second wound: after which we are told by some, that it remains torpid and inactive, without even attempting to escape.

The very instant the wound is inflicted, though small in itself, it appears more painful than the sting of a bee. This pain, which is so suddenly felt, far from abating, grows every moment more excruciating and dangerous: the limb swells; the venom reaches the head, which is soon of a monstrous size; the eyes are red and fiery; the heart beats quick, with frequent interruptions; the pain becomes insupportable, and some expire under it in five or six hours, but others, who are of stronger constitutions, survive the agony for a few hours longer, only to sink under a general mortification, which ensues and corrupts the whole body.

As a gentleman in Virginia was walking in the fields for his amusement, he accidentally trod upon a rattle-snake, that had been lurking in a stony place, which, enraged by the pressure, reared up, bit his hand, and shook its rattles. The gentleman readily perceived that he was in the most dreadful danger; but, unwilling to die unrevenged, he killed the snake, and carrying it home in his hand, threw it on the ground before his family, crying out, "I am killed, and there is my murderer!" In such an extremity the speediest remedies were the best. His arm, which was beginning to swell, was tied up near the shoulder, the wound was anointed with oil, and every precaution taken to stop the infection. By the help of a very strong constitution he recovered; but not without feeling the most various and dreadful symptoms for several weeks together. His arm, below the ligature, appeared of several colours, with a writhing among the muscles, that, to his terrified imagination, appeared like the motions of the animal that had wounded him. A fever ensued; the loss of his hair, giddiness, drought, weakness, and nervous faintings; till, by slow degrees, a very strong habit overpowered the latent malignity of the poison.

Several remedies have been tried to alleviate this calamity. A decoction of the Virginian snake-root is considered as the most

effectual; and at the same time the head of the animal bruised and laid upon the part affected, is thought to assist the cure. In general, however, it is found to be fatal; and the Indians, sensible of this, take care to dip their arrows in the poison under the rattle-snake's fangs, when they desire to take a signal revenge of their enemies.

Thus much concerning this animal is agreed upon by every naturalist; there are other circumstances in its history which are not so well ascertained. And first, its motion, which some describe as the swiftest imaginable, asserting, that its Indian name of *Ecacoalt*, which signifies the wind-serpent, implies its agility: others, on the contrary, assert, that it is the slowest and the most sluggish of all serpents; and that it seldom moves from one place. In this opposition of opinions, there are others who assert, that on even ground it moves but slowly, but then, among rocks, that it goes at a great rate. If we may argue from analogy, the opinion of those who contend for its slow motion seems the most probable, as the viper, which it so very much resembles, is remarkable among serpents for its inactivity.

It is said also by some, that the rattle-snake has a power of charming its prey into its mouth; and this is as strongly contradicted by others. The inhabitants of Pennsylvania are said to have opportunities of observing this strange fascination every day. The snake is often seen basking at the foot of a tree, where birds and squirrels make their residence. There, coiled upon its tail, its jaws extended, and its eyes shining like fire, the rattle-snake levels its dreadful glare upon one of the little animals above. The bird or the squirrel, whichever it may be, too plainly perceives the mischief meditating against it, and hops from branch to branch, with a timorous plaintive sound, wishing to avoid, yet incapable of breaking through the fascination; thus it continues for some time its feeble efforts and complaints, but is still seen approaching lower and lower towards the bottom branches of the tree, until, at last, as if overcome by the potency of its fears, it jumps down from the tree directly into the throat of its frightful destroyer.

In order to ascertain the truth of this story, a mouse was put into a large iron cage, where a rattle-snake was kept, and the effect carefully observed. The mouse remained motionless at one end of the cage, while the snake, at the other, continued fixed, with its eye glaring full on the little animal, and its jaws opened to their widest extent: the mouse for some time seemed eager to escape; but every effort only served to increase its terrors, and to draw it still nearer the enemy; till, after several ineffectual attempts to break the fascination, it was seen to run into the jaws of the rattle-snake, where it was instantly killed.

To these accounts the incredulous oppose the improbability of the fact; they assert that such a power ascribed to serpents, is only the remnant of a vulgar error, by which it was supposed that serpents could be charmed, and had also a power of charming.

They aver, that animals are so far from running down the throat of a rattle-snake in captivity, that the snake will eat nothing in that state, but actually dies for want of subsistence.

A serpent, called the Whip-snake, is still more venomous than the former. This animal, which is a native of the East, is about five feet long, yet not much thicker than the thong of a coachman's whip. It is exceedingly venomous; and its bite is said to kill in about six hours. One of the Jesuit Missionaries happening to enter into an Indian pagoda, saw what he took to be a whip-cord lying on the floor, and stooped to take it up; but upon handling it, what was his surprise to find that it was animated, and no other than the whip-snake, of which he had heard such formidable accounts! Fortune, however, seemed favourable to him, for he grasped it by the head, so that it had no power to bite him, and only twisted its folds up his arm. In this manner he held it, till it was killed by those who came to his assistance.

To this formidable class might be added the Asp, whose bite however is not attended with those drowsy symptoms which the ancients ascribed to it. The Jaculus of Jamaica also is one of the swiftest of the serpent kind. The Hæmorrhois, so called from the hæmorrhages which its bite is said to produce; the Seps, whose wound is very venomous, and causes the part affected to corrupt in a very short time; the Coral Serpent, which is red, and whose bite is said to be fatal. But of all others, the Cobra di Capello, or Hooded Serpent, inflicts the most deadly and incurable wounds. Of this formidable creature there are five or six different kinds; but they are all equally dangerous, and their bite followed by speedy and certain death. It is from three to eight feet long, with two large fangs hanging out of the upper jaw. It has a broad neck, and a mark of dark brown on the forehead; which, when viewed frontwise, looks like a pair of spectacles, but behind like the head of a cat. The eyes are fierce, and full of fire; the head is small, and the nose flat, though covered with very large scales, of a yellowish ash colour; the skin is white, and the large tumour on the neck is flat and covered with oblong smooth scales. The bite of this animal is said to be incurable, the patient dying in about an hour after the wound, the whole frame being dissolved into one putrid mass of corruption.*

[* "In the year 1759," says M. d'Obsonville, "I witnessed a very singular instance of the effects of the bite of one of these serpents, which happened in the midst of a corps of troops commanded by M. de Bussy. An Indian Gentoo merchant perceived a Mahometan soldier of his acquaintance going to kill one of these reptiles, which he had found sleeping under his packet; the Gentoo flew to beg its life, protesting it would do no hurt if it was not first provoked, passing at the same time his hand under its belly to carry it out of the camp, when suddenly it twisted round, and bit his little finger; upon which this unfortunate martyr of a fanatic charity gave a shriek, took a few steps, and fell down insensible. They flew to his assistance, applied the serpent-stone, fire, and

To remedy the bite of all these animals, perhaps salad-oil would be very efficacious: however, the Indians make use of a composition, which is called in Europe Petro di Cobra, or the Serpent Stone; and which, applied to the wound, is said to draw out the venom. The composition of this stone, for it is an artificial substance, is kept a secret; and perhaps its effects in extracting the venom may be imaginary: nevertheless, it is certain that it has a power of sticking to the skin, and sucking a part of the blood from the wound. This it may do somewhat in the same manner as we see a tobacco-pipe stick to the lips of a man who is smoking; yet still we are ignorant of the manner, and the secret might probably be of some use in medicine. It were to be wished, therefore, that those who go into India would examine into this composition, and give us the result of their inquiries; but I fear that it is not to benefit mankind, that our travellers now go to India.

CHAPTER X.

OF SERPENTS WITHOUT VENOM.

THE class of serpents without poison may be distinguished from those that are venomous by their wanting the fang teeth; their heads also are not so thick in proportion to their bodies; and, in general, they taper off to the tail more gradually in a point. But notwithstanding their being destitute of venom, they do not cease to be formidable: some grow to a size by which they become the most powerful animals of the forest; and even the smallest and most harmless of this slender tribe find protection from the similitude of their form.

The fangs make the great distinction among serpents, and all this tribe are without them. Their teeth are short, numerous, and in the smaller kinds, perfectly inoffensive; they lie in either jaw, as in frogs and fishes, their points bending backwards, the better to secure their prey. They want that artificial mechanism by which the poisonous tribe inflict such deadly wounds; they have no gland in the head for preparing venom, no conduits for conveying it to the teeth, no receptacles there, no hollow in the instrument that inflicts the wound. Their bite, when the teeth happen to be large enough to penetrate the skin, (for in general they are too small for this purpose), is attended with no other symptoms than those of an ordinary puncture; and many of this tribe, as if sensible of their own impotence, cannot be provoked to bite, though never so rudely assaulted. They hiss, dart out their forky

scarifications; but they were all ineffectual, his blood was already coagulated. About an hour after, I saw the body as they were going to burn it, and I thought I perceived some indications of a complete dissolution of the blood."]

tongues, erect themselves on the tail, and call up all their terrors to intimidate their aggressors; but seem to consider their teeth as unnecessary instruments of defence, and never attempt to use them. Even among the largest of this kind, the teeth are never employed in the most desperate engagements. When a hare or a bird is caught, the teeth may serve to prevent such small game from escaping; but when a buffalo or a tiger is to be encountered, it is by the strong folds of the body, by the fierce verberations of the tail, that the enemy is destroyed: by thus twining round, and drawing the knot with convulsive energy, this enormous reptile breaks every bone in the quadruped's body, and then at one morsel devours its prey.

From hence we may distinguish the unvenomous tribe into two kinds: first, into those which are seldom found of any considerable magnitude, and that never offend animals larger or more powerful than themselves, but which find their chief protection in flight, or in the doubtfulness of their form; secondly, into such as grow to an enormous size, fear no enemy, but indiscriminately attack all other animals and devour them. Of the first kind is the Common Black Snake, the Blind Worm, the Esculapian Serpent, the Amphisbœna, and several others. Of the second, the Liboya, the Boignacu, the Depona, and the Boiquatrara.

The Black Snake is the largest of English serpents, sometimes exceeding four feet in length. The neck is slender; the middle of the body thick; the back and sides covered with small scales; the belly with oblong, narrow, transverse plates; the colour of the back and sides is of a dusky brown; the middle of the back marked with two rows of small black spots, running from the head to the tail; the plates on the belly are dusky; the scales on the sides are of a bluish white; the teeth are small and serrated, lying on each side of the jaws in two rows. The whole species is perfectly inoffensive, taking shelter in dunghills, and among bushes in moist places; from whence they seldom remove, unless in the midst of the day in summer, when they are called out by the heat to bask themselves in the sun. If disturbed or attacked, they move away among the brambles with great swiftness; but if too closely pursued, they hiss and threaten, and thus render themselves formidable, though incapable of offending.

The black snake preys upon frogs, insects, worms, mice, and young birds; and, considering the smallness of the neck, it is amazing how large an animal it will swallow. The black snake of Virginia, which is larger than ours, and generally grows to six feet long, takes a prey proportionable to its size,—partridges, chickens, and young ducks. It is generally found in the neighbourhood of the hen-roost, and will devour the eggs even while the hen is sitting upon them: these it swallows whole; and often, after it has done the mischief, will roll itself round in the nest.

The whole of this tribe are oviparous, excluding eighty or a hundred eggs at a time, which are laid in dunghills or hot-beds,

bed, the heat of which, aided by that of the sun, brings them to maturity. During winter they lie torpid in banks of hedges, and under old trees.

The Blind Worm is another harmless reptile, with a formidable appearance. The usual length of this species is eleven inches. The eyes are red; the head small; the neck still more slender: from that part the body grows suddenly, and continues of an equal bulk to the tail, which ends quite blunt; the colour of the back is cinereous, marked with very small lines, composed of minute black specks; the sides are of a reddish cast; the belly dusky, and marked like the back. The motion of this serpent is slow; from which, and from the smallness of the eyes, are derived its names, some calling it the Slow, and some the Blind Worm. Like all the rest of the kind in our climates, they lie torpid during winter, and are sometimes found in vast numbers twisted together. This animal, like the former, is perfectly innocent; however, like the viper, it brings forth its young alive. Gesner tells us, that one of these being struck on the head when it was pregnant, it immediately cast forth its young.

The Amphisbæna, or the Double-headed Serpent, is remarkable for moving along with either the head or the tail foremost; and from thence it has been thought to have two heads. This error took its rise from the thickness of the tail, which at a distance may be mistaken for another head. Upon a nearer view, however, the error is easily discovered, and the animal will be found formed according to the usual course of nature. It is as thick at one end as at the other; and the colour of the skin is like that of the earth, being rough, hard, and variously spotted. Some have affirmed that its bite is dangerous; but this must be a mistake, as it wants the fangs, and consequently the elaboratory that prepares the poison.

These animals are only formidable from their similitude to the viper tribe; and in some countries where such reptiles are common, they make the distinction so exactly, that while they destroy serpents of one kind with great animosity, they take others into their houses, and even into their bosoms, with a kind of unaccountable affection. The Esculapian Serpent of Italy is among this number. It is there suffered to crawl about the chambers, and often gets into the beds where people lie. It is a yellow serpent, of about an ell long; and though innocent, yet will bite when exasperated. They are said to be great destroyers of mice, and this may be the reason why they are taken under human protection. The Boyuna of Ceylon is equally a favourite among the natives, and they consider the meeting it as a sign of good luck. The Surinam Serpent, which some improperly call the Ammodytes, is equally harmless and desirable among the savages of that part of the world. They consider themselves as extremely happy if this animal comes into their huts. The colours of this serpent are so many and beautiful that they surpass all description, and

these perhaps are the chief inducements to the savages to consider its visits as so very fortunate. A still greater favourite is the Prince of Serpents, a native of Japan, that has not its equal for beauty. The scales which cover the back are reddish, finely shaded, and marbled with large spots of irregular figures mixed with black. The fore part of the head is covered with large beautiful scales, the jaws bordered with yellow, the forehead marked with a black marbled streak, and the eyes handsome and lively. But of all others, the Gerenda of the East Indies is the most honoured and esteemed. To this animal, which is finely spotted with various colours, the natives of Calicut pay divine honours; and while their deity lies coiled up, which is its usual posture, the people fall upon their faces before it with stupid adoration. The African Gerenda is larger, and worshipped in the same manner by the inhabitants of the coasts of Mozambique. The skin is not so finely spotted as the former, but it is variegated all over the body with very fine white, ash-coloured, and black spots. The brilliancy of colouring in these reptiles would only serve with us to increase our disgust; but in those countries where they are common, distinctions are made, and even in this horrid class there are some eyes that can discover beauty.

But in the larger tribe of serpents there is nothing but danger to be apprehended. This formidable class, though without venom, have something frightful in their colour, as well as their size and form. They want that vivid hue with which the savages are so much pleased in the lesser kinds; they are all found of a dusky colour, with large teeth, which are more formidable than dangerous.

The first of this class is the Great Liboya of Java and Brasil, which Legaut affirms he has seen fifty feet long. Nor is he singular in this report, as many of the missionaries affirm the same; and we have the concurrent testimony of historians as a further proof. The largest animal of this kind which has been brought into Europe, is but thirty-six feet long; and it is probable, that much greater have been seen and destroyed, before they were thought worth sending so far to satisfy European curiosity. The most usual length, however, of the Liboya, is about twenty feet, and the thickness in proportion. The teeth are small in proportion to the body, nor are they used but when it seizes the smallest prey. It lies in wait for wild animals near the paths, and when it throws itself upon them, it wraps them round so closely as to break all the bones; then moistening the whole body over with its slaver, it makes it fit for deglutition, and swallows it whole.

The Boiguacu is supposed to be the next in magnitude, and has often been seen to swallow a goat whole. It is thickest in the middle of the body, and grows shorter and smaller towards the head and the tail; on the middle of the back there is a chain of small black spots running along the length of it; and on each side there are large round black spots, at some distance from each other, which are white in the centre; between these, near the belly,

there are two rows of lesser black spots, which run parallel to the back. It has a double row of sharp teeth in each jaw, of a white colour, and shining like mother-of-pearl. The head is broad, and over the eyes it is raised into two prominences; near the extremity of the tail there are two claws, resembling those of birds.

These serpents lie hid in thickets, from whence they sally out unawares, and raising themselves upright on their tails, will attack both men and beasts. They make a loud hissing noise when exasperated; and sometimes, winding up trees, will dart down upon travellers, and twist themselves so closely round their bodies, as to dispatch them in a very few minutes. Condamine, however, affirms, that their bite is not dangerous; for though the teeth are so large as to inspire the beholder with terror, yet the wound they make is attended with no dangerous consequences whatever. Dellon affirms, that they generally haunt desert places; and though they are sometimes seen near great towns, or on the banks of rivers, yet it is generally after some great inundation; he never saw any but what were dead, and they appeared to him like the trunk of a great tree lying on the ground.

To this class of large serpents we may refer the Depona, a native of Mexico, with a very large head and great jaws. The mouth is armed with cutting crooked teeth, among which there are two longer than the rest, placed in the fore part of the upper jaw, but very different from the fangs of the viper. All round the mouth there is a broad scaly border; and the eyes are so large, that they give it a very terrible aspect. The forehead is covered with very large scales, on which are placed others that are smaller, curiously ranged; those on the back are greyish, and along it runs a double chain, whose ends are joined in the manner of a buckler. Each side of the belly is marbled with large square spots, of a chesnut colour; in the middle of which is a spot, which is round and yellow. They avoid the sight of man, and consequently never do much harm.

Such are the most noted animals of the serpent tribe; but to recount all would be a vain as well as an useless endeavour. In those countries where they abound, their discriminations are so numerous, and the colour so various, that every thicket seems to produce a new animal. The same serpent is often found to bring forth animals of eight or ten different colours; and the naturalist who attempts to arrange them by that mark, will find that he has made distinctions which are entirely disowned by nature: however, a very considerable number might be added to enlarge the catalogue; but having supplied a general history, the mind turns away from a subject where every object presents something formidable or loathsome to the imagination. Indeed, the whole tribe resemble each other so nearly, that the history of one may almost serve for every other. They are all terrible to the imagination, al frightful to behold in their fury, and have long been considered as a race of animals between whom and man there is a natural antipathy.

PART I.

HISTORY OF INSECTS OF THE FIRST ORDER.

CHAPTER I.

OF INSECTS IN GENERAL.

HAVING gone through the upper ranks of nature, we descend to that of insects, a subject almost inexhaustible, from the number of its tribes and the variety of their appearance. Those who have professedly written on this subject, seem to consider it as one of the greatest that can occupy the human mind, as the most pleasing in animated nature. "After an attentive examination," says Swammerdam, "of the nature and anatomy of the smallest as well as the largest animals, I cannot help allowing the least an equal, or perhaps a superior degree of dignity. If, while we dissect with care the larger animals, we are filled with wonder at the elegant disposition of their parts, to what a height is our astonishment raised, when we discover all these parts arranged in the least in the same regular manner! Notwithstanding the smallness of ants, nothing hinders our preferring them to the largest animals; if we consider either their unwearied diligence, their wonderful strength, or their inimitable propensity to labour. Their amazing love to their young is still more unparalleled among the larger classes. They not only daily carry them to such places as may afford them food, but if by accident they are killed, and even cut into pieces, they with the utmost tenderness will carry them away piece-meal in their arms. Who can show such an example among the larger animals, which are dignified with the title of perfect? Who can find an instance in any other creature that can come in competition with this?"

Such is the language of a man, who by long study became enamoured of his Subject; but to those who judge less partially, it will be found that the insect tribe, for every reason, deserve but the last and lowest rank in animated nature. As in mechanics the most complicated machines are required to perform the nicest operations, in anatomy the noblest animals are most variously and wonderfully made. Of all living beings, Man offers the most wonderful variety in his internal conformation; quadrupeds come next; and other animals follow in proportion to their powers or their excellencies. Insects seem of all others the most imperfectly formed: from their minuteness, the dissecting knife can go but a short way in the investigation; but one thing argues an evident imperfection, which is, that many of them can live a long time,

though deprived of those organs which are necessary to life in the higher ranks of nature. Many of them are furnished with lungs and a heart like nobler animals; yet the caterpillar continues to live, though his heart and lungs, which is often the case, are entirely eaten away.

But it is not from their conformation alone that insects are inferior to other animals, but from their instincts also. It is true, that the ant and the bee present us with very striking instances of assiduity; but how far are theirs beneath the marks of sagacity exhibited in the hound or the stag! A bee taken from the swarm is totally helpless and inactive, incapable of giving the smallest variation to its instincts; it has but one single method of operating, and, if put from that, it can turn to no other. In the pursuits of the hound, there is something like a choice; in the labours of the bee, the whole appears like necessity or compulsion.

If insects be considered as bearing a relation to man, and as assisting him in the pleasures or necessities of life, they will, even in this respect, sink in the comparison with the larger tribes of nature. It is true, that the bee, the silk-worm, the cochineal-fly, and the cantharides, render him signal services; but how many others of this class are either noxious or totally unserviceable to him! Even in a country like ours, where all the noxious animals have been reduced by repeated assiduity, the insect tribes still maintain their ground, and are but too often unwelcome intruders upon the fruits of human industry. But, in more uncultivated regions, their annoyance and devastations are terrible. What an uncomfortable life must the natives lead in Lapland, and some parts of America, where, if a candle be lighted, the insects swarm in such abundance, as instantly to extinguish it with their numbers; where the inhabitants are obliged to smear their bodies and faces with tar, or some other composition, to protect them from the puncture of their minute enemies; where, though millions are destroyed, famished millions are still seen to succeed, and to make the torture endless!

Their amazing number is also an argument of their imperfection. It is a rule that obtains through all nature, that the nobler animals are slowly produced, and that nature acts with a kind of dignified economy; but the meaner births are lavished in profusion, and thousands are brought forth merely to supply the necessities of the more favourite objects of creation. Of all other productions in nature, insects are the most numerous. Vegetables, that cover the surface of the earth, bear no proportion to their multitudes; and though at first sight herbs of the field seem to be the parts of organized nature produced in the greatest abundance, yet upon minuter inspection we shall find every plant supporting a number of scarcely perceptible creatures, that fill up the various stages of youth, vigour, and age, in the compass of a few days' existence.

All other animals are capable of some degree of education; their instincts may be suppressed or altered; the dog may be taught to fetch and carry; the bird to whistle a tune; and the serpent to dance: but the insect has but one invariable method of operating; no arts can turn it from its instincts; and indeed its life is too short for instruction, as a single season often terminates its existence.

For these reasons, the insect tribe are deservedly placed in the lowest rank of animated nature; and, in general, they seem more allied to the vegetables on which they feed than to the noble classes above them. Many of them are attached to one vegetable, often to a single leaf: there they increase with the flourishing plant, and die as it decays; a few days fill up the measure of their contemptible lives; while the ends for which they were produced, or the pleasures they enjoyed, to us at least are utterly unknown.

Yet while I am thus fixing the rank of a certain class of animals, it seems necessary to define the nature of those animals which are thus degraded. Definitions in general produce little knowledge; but here, where the shades of nature are so intimately blended, some discrimination is necessary to prevent confusion. The smallness of the animal, for instance, does not constitute an insect; for then, many of the lizard kind, which are not above two inches long, would come under this denomination; and if the smaller lizards, why not the crocodile, which would be a terrible insect indeed! In the same manner, smallness, with a slow creeping motion, does not constitute an insect; for though snails might be called insects, with the same propriety the whole tribe of sea shell-fish would then have equal pretensions, and a very troublesome innovation would be brought into our language, which is already formed. Excluding such animals, therefore, from the insect tribe, we may define insects to be *little animals without red blood, bones, or cartilages, furnished with a trunk, or else a mouth, opening lengthwise, with eyes which they are incapable of covering, and with lungs which have their openings on the sides.* This definition comprehends the whole class of insects, whether with or without wings, whether in their caterpillar or butterfly state, whether produced in the ordinary method of generation between male and female, or from an animal that is itself both male and female, or from the same animal cut into several parts, and each part producing a perfect animal.

From hence it appears, that in this class of animals there are numerous distinctions, and that a general description will by no means serve for all. Almost every species has its own distinct history; and exhibits manners, appetites, and modes of propagation, peculiarly its own. In the larger ranks of existence, two animals that nearly resemble each other in form will be found to have a similar history; but here insects almost entirely alike will be often found perfectly dissimilar, as well in their manner of

ging forth and subsisting, as in the changes which they dergo during their short lives. Thus as this class is prolific yond computation, so are its varieties multiplied beyond the wer of description. The attempt to enumerate all the species a fly, or a moth, would be very fruitless; but to give a history f all would be utterly impracticable: so various are the appetites, he manners, and the lives of this humble class of beings, that every species requires its distinct history. An exact plan, therefore, of nature's operations in this minute set of creatures is not to be expected; and yet such a general picture may be given, as is sufficient to show the protection which Providence affords its smallest as well as its largest productions, and to display that admirable circulation in nature, by which one set of living beings finds subsistence from the destruction of another, and by which life is continued without a pause in every part of the creation.

Upon casting a slight view over the whole insect tribe, just when they are supposed to rouse from their state of annual torpidity, when they begin to feel the genial influence of spring, and again exhibit new life in every part of nature, their numbers and their varieties seem to exceed all powers of calculation, and they are indeed too great for description. When we look closer, however, we shall find some striking similitudes, either in their propagation, their manners, or their form, that give us a hint for grouping several of them into one description, and thus enabling us to shorten the labour of a separate history for ever species. Swammerdam, Reaumur, and Linnæus, have each attempted to abridge the task of description, by throwing a number of similar animals into distinct classes, and thus making one general history stand for all. I will avail myself of their labours, and, uniting their general distinctions, throw the whole class of insects into four separate distributions, giving under each the history of every species that seems to me considerable enough to deserve our notice. Thus our labour will be shortened; and the very rank in which an insect is placed, will, in some measure, exhibit a considerable part of its history.

In our cursory inspection of the insect tribe, the first animals that offer themselves are those which want wings, that appear crawling about on every plant, and on every spot of earth we regard with any degree of attention. Of these, some never obtain wings at any period of their existence, but are destined to creep on the vegetable, or the spot of earth, where they are stationed, for their whole lives. On the contrary, others are only candidates for a more happy situation, and only wait their growing wings, when they may be said to arrive at their state of full perfection.

Those that never have wings, but creep about till they die, may be considered as constituting the *first* class of insects. All these, the flea and the wood-louse only excepted, are produced from an egg; and when once they break the shell, they never suffer any

further change of form, but continue to grow larger till they die. Thus the louse or the spider are produced from an egg, never suffering any alteration when once they are excluded, but, like the chicken or the duck, remaining invariably the same, from their birth to their dissolution.

The *second* order of insects consists of such as have wings; but which, when produced from the egg, have those wings cased up in such a manner as not to appear. This casing up of the wings, however, does not prevent the animal's running, leaping, and moving, with its natural celerity; but when the case bursts, and the wings have a power of expanding, all the animal's motions become more extensive, and the animal arrives at full perfection. Thus the grasshopper, the dragon-fly, and the ear-wig, have their wings at first bound down; but when the skin that, like a pair of stays, kept them confined, bursts, they are then expanded, and the animal pursues the purposes for which it was produced.

The *third* order of insects is of the moth and butterfly kind. These all have four wings, each covered with a mealy substance of various colours, which when handled comes off upon the fingers; and, if examined by the microscope, will appear like scales, with which the wing is nicely embroidered all over. These insects also are produced in a manner peculiar to themselves. They are first hatched from an egg, from whence proceeds a caterpillar that eats, and often casts its skin: the caterpillar having divested itself for the last time, assumes a new covering, which is called a chrysalis, or the cone in the silk-worm, in which it continues hidden till it comes forth a perfect moth or butterfly.

The *fourth* order is of those winged insects which come from a worm instead of a caterpillar, and yet go through changes similar to those which moths and butterflies are seen to undergo. They are first excluded from the egg as a worm, and then become a chrysalis; in some, their wings and legs are seen; in others, the animal is quite detached from the cone in which it is concealed; but all at length break their prison, and come out perfect winged animals, some furnished with two wings, and some with four. The wings of all these differ from those of the butterfly and moth kind, by not having the mealy scales which are ever found on the wings of the former. In this class we may place the numerous tribes of gnats, beetles, bees, and flies.

To these I will add, as a *fifth* order, a numerous tribe lately discovered, to which naturalists have given the name of Zoophytes. These do not go through the ordinary forms of generation, but may be propagated by dissection. Some of these, though cut into a hundred parts, still retain life in each, and are endued with such a vivacious principle, that every part will in a short time become a perfect animal. They seem a set of creatures placed between animals and vegetables, and make the shade that connects animated and insensible nature. To this class belong the polypus, the earth-worm, and all the varieties of the sea-nettle.

Having thus given a general distribution of insects, I will proceed to describe each class in the order I have mentioned them; beginning with insects without wings, as they more nearly resemble the higher ranks of nature, as well in their habits as their conformation.

CHAPTER II.

OF INSECTS WITHOUT WINGS.

EVERY moment's observation furnishes us with instances of insects without wings; but the difficulty is to distinguish those which are condemned continually to lead reptile lives, from such as only wait the happy moment of transmutation. For this nothing but a long and intimate acquaintance will suffice; but in general, all animals resembling the flea, the louse, the spider, the bug, the wood-louse, the water-louse, and the scorpion, never acquire wings, but are produced from the egg in that form, which they never change afterwards.

If we consider this class as distinct from others, we shall find them in general longer lived than the rest, and often continuing their term beyond one season, which is the ordinary period of an insect's existence. They seem also less subject to the influence of the weather, and often endure the rigours of winter without being numbed into torpidity. The whole race of moths, butterflies, bees, and flies, are rendered lifeless by the return of cold weather; but we need not be told, that the louse, the flea, and many of these wingless creatures that seem formed to tease mankind, continue their painful depredations the whole year round.

They come to perfection in the egg, as was said before; and it sometimes happens, that when the animal is interrupted in performing the offices of exclusion, the young ones burst the shell within the parent's body, and are thus brought forth alive. This not unfrequently happens with the wood-louse, and others of the kind, which are sometimes seen producing eggs, and sometimes young ones perfectly formed.

Though these creatures are perfect from the beginning, yet they are often, during their existence, seen to change their skin: this is a faculty which they possess in common with many of the higher ranks of animals, and which answers the same purposes. However tender their skins may seem to our feel, yet, if compared to the animal's strength and size, they will be found to resemble a coat of mail, or, to talk more closely, the shell of a lobster. By this skin these animals are defended from accidental injuries, and particularly from the attacks of each other. Within this they continue to grow, till their bodies become so large as to be imprisoned in their own

covering, and then the shell bursts, but is quickly replaced by a new one.

Lastly, these animals are endued with a degree of strength for their size, that at first might exceed credibility.—Had man an equal degree of strength, bulk for bulk, with a louse or flea, the history of Sampson would be no longer miraculous. A flea will draw a chain a hundred times heavier than itself; and, to compensate for this force, will eat ten times its own size of provision in a single day.

CHAPTER III.

OF THE SPIDER, AND ITS VARIETIES.

The animal that deserves our first notice in this principal order of insects is the Spider, whose manners are of all others the most subtle, and whose instincts are most various. Formed for a life of rapacity, and incapable of living upon any other than insect food, all its habits are calculated to deceive and surprise: it spreads toils to entangle its prey, it is endued with patience to expect its coming, and is possessed of arms and strength to destroy it when fallen into the snare.

In this country, where all the insect tribes are kept under by human assiduity, the spiders are but small and harmless. We are acquainted with few but the House Spider, which weaves its web in neglected rooms; the Garden Spider, that spreads its toils from tree to tree, and rests in the centre; the Wandering Spider, that has no abode like the rest; and the Field Spider, that is sometimes seen mounting, web and all, into the clouds. These are the chief of our native spiders, which, though reputed venomous, are entirely inoffensive. But they form a much more terrible tribe in Africa and America. In those regions, where all the insect species acquire their greatest growth, where the butterfly is seen to expand a wing as broad as our sparrow, and the ant to build an habitation as tall as a man, it is not to be wondered at that the spiders are seen bearing a proportionable magnitude. In fact, the bottom of the Martinico spider's body is as large as a hen's egg, and covered all over with hair. Its web is strong, and its bite dangerous. It is happy for us, however, that we are placed at a distance from these formidable creatures, and that we can examine their history without feeling their resentment.

Every spider has two divisions in its body. The fore part, containing the head and breast, is separated from the hinder part or belly by a very slender thread, through which, however, there is communication from one part to the other. The fore part is covered with a hard shell, as well as the legs which adhere to the breast. The hinder part is clothed with a supple skin, beset all over with

hair. They have several eyes all round the head, brilliant and acute; these are sometimes eight in number, sometimes but six; two behind, two before, and the rest on each side. Like all other insects, their eyes are immoveable, and they want eyelids; but this organ is fortified with a transparent horny substance, which at once secures and assists their vision. As the animal procures its subsistence by the most watchful attention, so large a number of eyes was necessary to give it the earliest information of the capture of its prey. They have two pincers on the fore part of the head, rough, with strong points, toothed like a saw, and terminating in claws like those of a cat. A little below the point of the claw there is a small hole through which the animal emits a poison, which, though harmless to us, is sufficiently capable of instantly destroying its prey. This is the most powerful weapon they have against their enemies: they can open or extend these pincers as occasion may require, and when they are undisturbed, they suffer them to lie one upon the other, never opening them but when there is a necessity for their exertion. They have all eight legs, jointed like those of lobsters, and similar also in another respect; for if a leg be torn away, or a joint cut off, a new one will quickly grow in its place, and the animal will find itself fitted for combat as before. At the end of each leg there are three crooked moveable claws; namely, a small one, placed higher up, like a cock's spur, by the assistance of which it adheres to the threads of its web: there are two others larger, which meet together like a lobster's claw, by which they can catch hold of the smallest depressions, walking up or down the most polished surfaces, on which they can find inequalities that are imperceptible to the grosser sight. But when they walk upon such bodies as are perfectly smooth, as looking-glass or polished marble, they squeeze a little sponge, which grows near the extremity of their claws, and thus diffusing a glutinous substance, adhere to the surface until they make a second step. Besides the eight legs just mentioned, those animals have two others, which may more properly be called arms, as they do not serve to assist motion, but are used in holding and managing their prey.

The spider, though thus formidably equipped, would seldom prove successful in the capture, were it not equally furnished with other instruments to assist its depredations. As it lives wholly upon flies, and is without wings to pursue them, it is obvious they must for ever escape so impotent an adversary; but the spider is a most experienced hunter, and spreads its nets to catch those animals it is unable to pursue. The spider's web is generally laid in those places where flies are most apt to come and shelter; in the corners of rooms, round the edges of windows, and in the open air among the branches of the trees. There the little animal remains for days, nay weeks together, in patient expectation, seldom changing its situation though never so unsuccessful.

For the purposes of making this web, nature has supplied this

animal with a large quantity of glutinous matter within its body, and five dugs or teats for spinning it into thread. This substance is contained in a little bag, and at first sight it resembles soft glue; but when examined more accurately, it will be found twisted into many coils of an agate colour, and upon breaking it the contents may be easily drawn out into threads, from the tenacity of the substance, not from those threads being already formed. Those who have seen the machine by which wire is spun, will have an idea of the manner in which this animal forms the threads of its little net, the orifices of the five teats above-mentioned, through which the thread is drawn, contracting or dilating at pleasure. The threads which we see, and appear so fine, are notwithstanding composed of five joined together, and these are many times doubled when the web is in formation.

When a house spider proposes to begin a web, it first makes a choice of some commodious spot, where there is an appearance of plunder and security. The animal then distils one little drop of its glutinous liquor, which is very tenaceous, and then creeping up the wall, and joining its thread as it proceeds, it darts itself in a very surprising manner, as I have often seen, to the opposite place, where the other end of the web is to be fastened. The first thread thus formed, drawn tight and fixed at each end, the spider then runs upon it backward and forward, still assiduously employed in doubling and strengthening it, as upon its force depends the strength and stability of the whole. The scaffolding thus completed, the spider makes a number of threads parallel to the first in the same manner, and then crosses them with others; the clammy substance of which they are formed serving to bind them, when newly made, to each other.

The insect, after this operation, doubles and trebles the thread that borders its web, by opening all its teats at once, and secures the edges so as to prevent the wind from blowing the work away. The edges being thus fortified, the retreat is next to be attended to; and this is formed like a funnel at the bottom of the web, where the little creature lies concealed. To this are two passages or outlets, one above and the other below, very artfully contrived, to give the animal an opportunity of making excursions at proper seasons, of prying into every corner, and cleaning those parts which are observed to be clogged or encumbered. Still attentive to its web, the spider, from time to time, cleans away the dust that gathers round it, which might otherwise clog and discommode it: for this purpose it gives the whole a shake with its paws, still, however, proportioning the blow so as not to endanger the fabric. It often happens also, that from the main web there are several threads extended at some distance on every side; these are, in some measure, the out-works of the fortification, which, whenever touched from without, the spider prepares for attack or self-defence. If the insect impinging be a fly, it springs forward with great agility; if, on the contrary, it be the assault of an enemy stronger than itself, it keeps

within its fortress, and never ventures out till the danger be over. Another advantage which the spider reaps from this contrivance of a cell or retreat behind the web is, that it serves for a place where the creature can feast upon its game with all safety, and conceal the fragments of those carcasses which it has picked, without exposing to public view the least trace of barbarity, that might create a suspicion in any insects that their enemy was near.

It often happens, however, that the wind, or the rustling of the branches, or the approach of some large animal, destroys in a minute the labours of an age. In this case, the spider is obliged to remain a patient spectator of the universal ruin; and when the danger is passed away, it sets about repairing the calamity. For this purpose, it is furnished with a large store of the glutinous substance of which the web is made, and with this it either makes a new web, or patches up the old one. In general, however, the animal is much fonder of mending than making, as it is furnished originally with but a certain quantity of glutinous matter, which, when exhausted, nothing can renew. The time seldom fails to come when their reservoirs are entirely dried up, and the poor animal is left to all the chances of irretrievable necessity. An old spider is thus frequently reduced to the greatest extremity; its web is destroyed, and it wants the materials to make a new one. But as these animals have been long accustomed to a life of shifting, it hunts about to find out the web of another spider, younger and weaker than itself, with whom it ventures a battle. The invader generally succeeds; the young is driven out to make a new web, and the old one remains in quiet possession. If, however, the spider is unable to dispossess any other of its web, it then endeavours for a while to subsist upon accidental depredations, but in two or three months it inevitably dies of hunger.

The Garden Spider seems to work in a different manner. The method with this insect is, to spin a great quantity of thread, which, floating in the air in various directions, happens, from its glutinous quality, at last to stick to some object near it, a lofty plant or the branch of a tree. The spider only wants to have one end of the line fast, in order to secure and tighten the other. It accordingly draws the line when thus fixed, and then, by passing and repassing upon it, strengthens the thread in such a manner as to answer all its intentions. The first cord being thus stretched, the spider walks along a part of it, and there fastens another, and dropping from thence, fastens the thread to some solid body below, then climbs up again and begins a third, which it fastens by the same contrivance. When three threads are thus fixed, it forms a square, or something that very nearly resembles one, and in this the animal is generally seen to reside. It often happens, however, when the young spider begins spinning, that its web becomes too buoyant, and not only the thread floats in the air, but even the little spinster. In this manner we have often seen the threads of spiders floating in the air; and what is still more surprising, the young spiders them-

selves attached to their own web. The reason is obvious; for as even gold itself may be so finely drawn out as to float in the air, so the finer thread of a spider is so buoyant as not only to swim in the air, but also to lift the spider itself; which, like the tail of a kite, rises with its own manufacture.

The spider's web being thus completed, and fixed in a proper place, its next care is to seize and secure whatever insect happens to be caught in the toil. For this purpose, it remains for weeks and even months upon the watch, without ever catching a single fly; for the spider, like most other insects, is surprisingly patient of hunger. It sometimes happens that too strong a fly strikes itself against the web, and thus, instead of being caught, tears the net to pieces. In general, however, the butterfly or the hornet, when they touch the web, fly off again, and the spider seems no ways disposed to interrupt their retreat. The large blue-bottle fly, the ichneumon fly, and the common meat-fly, seem to be its favourite game. When one of these strike into the toils, the spider is instantly seen alert and watchful at the mouth of its hole, careful to observe whether the fly be completely immeshed. If that be the case, the spider walks leisurely forward, seizes its prey, and instantly kills it, by instilling a venomous juice into the wound it makes. If, however, the fly be not entirely immeshed, the spider patiently waits, without appearing, until its prey has fatigued itself by its struggles to obtain its liberty; for if the ravager should appear in all his terrors while the prey is but half involved, a desperate effort might give it force enough to get free. If the spider has fasted for a long time, it then drags the fly immediately into its hole and devours it; but if there has been plenty of game, and the animal be no way pressed by hunger, it then gives the fly two or three turns in its web, so as completely to immesh it, and there leaves it impotently to struggle until the little tyrant comes to its appetite. Why the spider should at one time kill its prey, and at another suffer it to struggle in the toils for several hours together, I am not able to say; perhaps it only likes its prey newly killed, and therefore delays to put the captive to death until it is to be eaten.

It has been the opinion of some philosophers, that the spider was in itself both male and female; but Lister has been able to distinguish the sexes, and to perceive that the males were much less in size than the females. But this is not the chief peculiarity; for, different from all other animals, except the fish called the Ray, it has its instruments of generation placed in the fore-arms, which have been already described. When these animals copulate, they for some time seize each other with their legs and arms: then appear the instrument of generation in the male, as if bursting out from the points of its fore-feet, and are inserted into the receptacle beneath the body of the female.

The female generally lays from nine hundred to a thousand eggs in a season: they are of a bluish colour, speckled with black, and

separated from each other by a glutinous substance, not unlike frog-spawn water. These eggs are large or small in proportion to the size of the animal that produces them. In some they are as large as a grain of mustard-seed, in others they are scarcely visible. The female never begins to lay till she be two years old at the least, and her first brood is never so numerous as when she has come to her greatest maturity.

When the number of eggs which the spider has brought forth have remained for an hour or two to dry after exclusion, the little animal then prepares to make them a bag, where they are to be hatched until they leave the shell. For this purpose she spins a web four or five times stronger than that made for catching flies; and, besides, lines it within-side by a down, which she plucks from her own breast. This bag, when completed, is as thick as paper, is smooth within-side, but rough without. Within this they deposit their eggs; and it is almost incredible to relate the concern and industry which they bestow in the preservation of it. They stick it by means of their glutinous fluid to the end of their body; so that the animal when thus loaded, appears as if she had one body placed behind another. If this bag be separated from her by any accident, she employs all her assiduity to stick it again in its former situation, and seldom abandons her treasure but with her life. When the young ones are excluded from their shells, within the bag, they remain for some time in their confinement, until the female, instinctively knowing their maturity, bites open their prison, and sets them free. But her parental care does not terminate with their exclusion; she receives them upon her back for some time, until they have strength to provide for themselves, when they leave her never to return, and each begins a separate manufactory of its own. The young ones begin to spin when they can scarcely be discerned; and prepare for a life of plunder before they have strength to overcome. Indeed nature seems to have formed them in every respect for a life of hostility. No other insect is possessed of such various powers of assault and defence; and they are able to destroy animals ten times bigger than themselves. Even after a severe defeat they quickly recover of their wounds; and as for their legs, they consider the loss of them but a small misfortune, as they grow again very speedily to their former magnitude.

Thus there is no insect to which they are not an enemy; but what is more barbarous still, spiders are the enemies of each other. M. Reaumur, who was fond of making experiments upon insects, tried to turn the labours of the spider to human advantage, and actually made a pair of gloves from their webs. For this purpose he collected a large number of those insects together; he took care to have them constantly supplied with flies, and the ends of young feathers, fresh picked from chickens and pigeons, which, being full of blood, are a diet that spiders are particularly fond of. But notwithstanding all his care, he was soon convinced that it was

impracticable to rear them, since they were of such a malignant nature that they could never be brought to live in society, but, instead of their usual food, chose to devour each other. Indeed, were it practicable to reconcile them to each other, it would require too much attendance to rear up a sufficient number to make the project any way useful. Their thread is four, if not five times finer than that of the silk-worm; so that, upon the smallest calculation, there must have been sixty thousand spiders to make a single pound of silk. That which Reaumur made use of, was only the web in which they deposited their eggs, which is five times stronger than their ordinary manufacture.

Of this animal there are several kinds, slightly differing from each other either in habits or conformation. The Water Spider is the most remarkable of the number. This insect resembles the common spider in its appearance, except that its hinder part is made rather in the shape of a nine-pin than a ball. They differ in being able to live as well by land as water, and in being capable of spinning as well in one element as the other. Their appearance under water is very remarkable, for though they inhabit the bottom, yet they are never touched by the element in which they reside, but are enclosed in a bubble of air, that, like a box, surrounds them on every side. This bubble has the bright appearance, at the bottom, of quicksilver; and within this they perform their several functions of eating, and sleeping, without its ever bursting, or in the least disturbing their operations: sometimes the bubble is seen divided into three distinct apartments; and, in the spring, the male enters one of those to impregnate the female, in the manner mentioned above, while the bubble in which he was contained unites with the other, like two drops of water, when approached to each other. They spin their webs as well in the water as upon land; and it is most probable that they make their food of the small insects of either element.

The Tarantula is also of this species, and deserves particular notice, not for any remarkable properties that really attend it, but for the numerous falsehoods which have been propagated concerning it. What may be said with truth concerning it is, that it is the largest of the spider kind known in Europe, and is a native of Apulia in Italy. Its body is three quarters of an inch long, and about as thick as one's little finger; the colour is generally an olive brown, variegated with one that is more dusky; it has eight legs and eight eyes, like the rest, and nippers which are sharp and serrated; between these and the fore-legs there are two little horns or feelers, which it is observed to move very briskly when it approaches its prey. It is covered all over the body with a soft down; and propagates as other spiders, by laying eggs. In the summer months, particularly in the dog-days, the tarantula, creeping among the corn, bites the mowers and passengers; but in winter it lurks in holes and is seldom seen.

Thus far is true; but now the fable begins: for though the bite

is attended with no dangerous symptoms, and will easily cure of itself, wonderful stories are reported concerning its virulence. The part which is bitten, as we are told, is soon after discoloured with a livid black, or yellowish circle, attended with an inflammation. At first the pain is scarcely felt; but a few hours after come on a violent sickness, difficulty of breathing, fainting, and sometimes trembling. The person bit, after this, does nothing but laugh, dance, skip about, putting himself into the most extravagant postures, and sometimes also is seized with a most frightful melancholy. At the return of the season in which he was bit, his madness begins again; and the patient always talks of the same things. Sometimes he fancies himself a shepherd, sometimes a king, appearing entirely out of his senses. These troublesome symptoms sometimes return for several years successively, and at last terminate in death. But so dreadful a disorder has, it seems, not been left without a remedy; which is no other than a well-played fiddle. For this purpose the medical musician plays a particular tune, famous for the cure, which he begins slow, and increases in quickness as he sees the patient affected. The patient no sooner hears the music, but he begins to dance, and continues so doing till he is all over in a sweat, which forces out the venom that appeared so dangerous. This dancing sometimes continues for three or four hours before the patient is weary, and before the sweating is copious enough to cure the disorder. Such are the symptoms related of the tarantula poison, symptoms which some of the best and gravest physicians have credited, and attempted to account for. But the truth is, that the whole is an imposition of the peasants upon travellers who happen to pass through that part of the country, and who procure a trifle for suffering themselves to be bitten by the tarantula. Whenever they find a traveller willing to try the experiment, they readily offer themselves; and are sure to counterfeit the whole train of symptoms which music is supposed to remove. A friend of mine who has passed through that part of the country, had a trusty servant bitten, without ever administering the musical cure; the only symptoms were a slight inflammation, which was readily removed, and no other consequence ever attended the bite.—It is thus that falsehoods prevail for a century or two; and mankind at last begin to wonder how it was possible to keep up the delusion so long.

FLEA.

SCORPION.

CHAPTER IV.

OF THE FLEA.

The history of those animals with which we are the best acquainted, are the first objects of our chiefest curiosity. There are few but are well informed of the agility and blood-thirsty disposition of the Flea, of the caution with which it comes to the attack, and the readiness with which it avoids the pursuit. This insect, which is not only the enemy of mankind, but of the dog, cat, and several other animals, is found in every part of the world, but bites with greater severity in some countries than in others. Its numbers in Italy and France are much greater than in England; and yet its bite is much more troublesome here than I have found it in any other place. It would seem that its force increased with the coldness of the climate, and, though less prolific, that it became more predaceous.

If the flea be examined with a microscope, it will be observed to have a small head, large eyes, and a roundish body. It has two feelers, or horns, which are short, and composed of four joints; and between these lies its trunk, which it buries in the skin, and through which it sucks the blood in large quantities. The body appears to be all over curiously adorned with a suit of polished sable armour, neatly jointed, and beset with multitudes of sharp pins, almost like the quills of a porcupine. It has six legs, the joints of which are so adapted, that it can, as it were, fold them up one within another; and when it leaps, they all spring out at once, whereby its whole strength is exerted, and the body raised above two hundred times its own diameter.

The young fleas are at first a sort of nits or eggs, which are round and smooth, and from these proceed white worms, of a shining pearl colour; and in a fortnight's time they come to a tolerable size, and are very lively and active, but if they are touched at this time, they roll themselves up in a ball: soon after this they begin to creep, like silk-worms that have no legs, and then they seek a place to lie hid in, where they spin a silken thread from their mouth, and with this they enclose themselves in a small round bag or case, as white within as writing paper, but dirty without; in this they continue for a fortnight longer, after which they burst from their confinement perfectly formed, and armed with powers to disturb the peace of an emperor.

CHAPTER V.

OF THE LOUSE, AND ITS VARIETIES.

The antipathies of mankind are various; some considering the toad, some the serpent, some the spider, and some the beetle, with a strong degree of detestation; but while all wonder at the strangeness of each other's aversions, they all seem to unite in their dislike to the Louse, and regard it as their natural and most nauseous enemy. Indeed, it seems the enemy of man in the most odious degree; for wherever wretchedness, disease, or hunger seize upon him, the louse seldom fails to add itself to the tribe, and to increase in proportion to the number of his calamities.

In examining the human louse with the microscope, its external deformity first strikes us with disgust: the shape of the fore part of the head is somewhat oblong, that of the hind part somewhat round; the skin is hard, and being stretched, transparent, with here and there several bristly hairs; in the fore part is a proboscis or sucker, which is seldom visible; on each side of the head are antennæ, or horns, each divided into five joints, covered with bristly hair, and several white vessels are seen through these horns; behind these are the eyes, which seem to want those divisions observable in other insects, and appear encompassed with some few hairs; the neck is very short, and the breast is divided into three parts, on each side of which are placed six legs, consisting of six joints covered also with bristly hairs: the ends of the legs are armed with two smaller and larger ruddy claws, serving those insects as a finger and thumb, by which they catch hold of such objects as they approach: the end of the body terminates in a cloven tail, while the sides are all over hairy; the whole resembling clear parchment, and, when roughly pressed, cracking with a noise.

When we take a closer view, its white veins, and other internal parts appear; as likewise a most wonderful motion in its intestines, from the transparency of its external covering. When the louse feeds, the blood is seen to rush, like a torrent, into the stomach; and its greediness is so great, that the excrements contained in the intestines are ejected at the same time, to make room for this new supply.

The louse has neither beak, teeth, nor any kind of mouth, as Dr. Hooke described it; for the entrance into the gullet is absolutely closed. In the place of these it has a proboscis, or trunk, or, as it may be otherwise called, a pointed hollow sucker, with which it pierces the skin, and sucks the human blood, taking that for food only. The stomach is lodged partly in the breast and back, but the greatest portion of it is in the abdomen. When swoln with blood, it appears of a dark brown colour, which is visible through the skin; and is either a faint red, or a full or bright brown, as the contents of the stomach are more or less changed. When it is

empty, it is colourless; but when filled it is plainly discernible, and its motion seems very extraordinary. It then appears working with very strong agitations, and somewhat resembles an animal within an animal. Superficial observers are apt to take this for the pulsation of the heart; but if the animal be observed when it is sucking, it will be found that the food takes a direct passage from the trunk to the stomach, where the remainder of the old aliment will be seen mixing with the new, and agitated up and down on every side.

If this animal be kept from food two or three days, and then placed on the back of the hand, or any soft part of the body, it will immediately seek for food; which it will the more readily find, if the hand be rubbed till it grows red. The animal then turns its head, which lies between the two fore-legs, to the skin, and diligently searches for some pore: when found, it fixes the trunk therein; and soon the microscope discovers the blood ascending through the head, in a very rapid, and even frightful stream. The louse has at that time sufficient appetite to feed in any posture; it is then seen sucking with its head downward, and its tail elevated. If, during this operation, the skin be drawn tight, the trunk is bound fast, and the animal is incapable of disengaging itself; but it more frequently suffers from its gluttony, since it gorges to such a degree, that it is crushed to pieces by the slightest impression.

Whether lice are distinguished by the parts of generation into males and females, is not yet discovered: Swammerdam is inclined to think that they are hermaphrodites, having found an ovary in all those he examined; and he dissected not less than forty-two. In one of these animals were found ten large eggs; and forty-four smaller, that were not yet come to their full perfection.

There is scarcely any animal that multiplies so fast as this unwelcome intruder. It has been pleasantly said, that a louse becomes a grandfather in the space of twenty-four hours: this fact cannot be ascertained; but nothing is more true than that the moment the nit, which is no other than the egg of the louse, gets rid of its superfluous moisture, and throws off its shell, it then begins to breed in its turn. Nothing so much prevents the increase of this nauseous animal, as cold and want of humidity; the nits must be laid in a place that is warm, and moderately moist, to produce any thing. This is the reason that many nits laid on the hairs in the night-time, are destroyed by the cold of the succeeding day, and so stick for several months, till they at last come to lose even their external form.

The louse is found upon every part of the human body, but particularly in the heads of children. Those found upon the miners in Sweden, are said by Linnæus to be very large; and he is of opinion, that the head and the body louse differ in no respect from each other. The Phthiriasis, or lousy disease, though very little known at present, was frequent enough among the ancients: Herod, Antiochus Epiphanes, Alcman the poet, Pherecydes, Cassander, Callisthenes,

and Sylla, all died of this disorder. The use of mercury, which was unknown among the ancients, may probably have banished it from among the moderns; for certain it is, that those animals seldom attack any in our climate, but such as from sloth or famine invite their company.

Such is the history of the human louse, which from its connexion with mankind, deserves first notice; but it would be endless to describe the various tribes that go under this name, and swarm upon every part of nature. There is scarcely an animal, and scarcely even a vegetable, that does not suffer under its own peculiar louse. The sheep, the horse, the hog, and the elephant, are all teazed by them; the whale, the shark, the salmon, and the lobster, are not without their company; while every hot-house and every garden is infested with some peculiarly destructive. Linnæus tells us, that he once found a vegetable louse upon some plants newly arrived from America; and, willing to trace the little animal through its various stages, he brought it with him from London to Leyden, where he carefully preserved it during the winter, until it bred in the spring: but the louse, it seems, did not treat him with all the gratitude he expected; for it became the parent of so numerous a progeny, that it soon overran all the physic garden of that beautiful city, and leaves to this day many a gardener to curse the Swede's too indulgent curiosity.

The animal which some have called the Leaf Louse, is of the size of a flea, and of a bright green, or bluish-green colour; the body is nearly oval, and is largest and most convex on the hinder part; the breast is very small, and the head is blunt and green; the eyes may be seen very plainly, being prominent on the fore part of the head, and of a shining black colour; near these there is a black line on each side; and the legs are very slender.

These animals are usually found upon the leaves of the orache, and other plants; and the weaker the leaves and the buds are, these insects swarm upon them in greater abundance. Some plants are covered over with them, though they are not the cause of the plant's weakness, but the sign: however, by wounding and sucking the leaf, they increase the disease. They generally assume their colour from the plant on which they reside. Those that feed upon pot herbs and plum trees, are of an ash colour, only they are greenish when they are young; those that belong to the alder and cherry tree are black, as also those upon beans, and some other plants; those on the leaves of the apple and rose trees are white, but as they leap like grasshoppers, some place them in the number of the flea kind. The most uncommon colour is reddish; and lice of this sort may be found on the leaves of the tansey; and their juice, when rubbed in the hands, tinges them with no disagreeable red. All these live upon their respective plants, and are often engendered within the very substance of the leaf.

All these bring forth their young alive; and the fœtus, when it is ready to be brought forth, entirely fills the belly of the female, its

fore parts being excluded first, and then the hinder. The young one does not begin to move till the horns or feelers appear out of the body of the old one; and by the motion of these it first shows signs of life, moving them in every direction, and bending all their joints. When the horns and head are excluded, the two fore feet follow, which they move with equal agility; after this follow the middle feet, and then the hinder; still, however, the young one continues sticking to its parent, supported only at one extremity, and hanging as it were in air until its small and soft members become hardened and fitted for self-support. The parent then gets rid of its burden by moving from the place where she was sitting, and, forcing the young one to stand upon its legs, leaves it to shift for itself.

As the animal has not far to go, its provision lying beneath it, during the summer it continues to eat and creep about with great agility. But as it is viviparous, and must necessarily lurk somewhere in winter, where its body may be defended from the cold, it endeavours to secure a retreat near the trees or plants that serve to nourish it in the beginning of the spring. They never hide themselves in the earth, like many other insects, because they have no part of their bodies fitted to remove the earth; nor can they creep into every chink, as their legs are too long; besides, their bodies are so tender, that the least rough particle of the earth would hurt them. They therefore get into the deep chinks of the bark, and into the cavities of the stronger stalks, from whence they sally out upon the branches and leaves, when the warmth of the sun begins to be felt. Neither the cold in the autumnal season, nor the lesser degree of heat in the spring, ever hurts them; they seldom, therefore, seek for hiding-places before the fall of the leaf, and are alert enough to take the earliest advantage of the returning spring.

Like many other insects, they cast their skins four several times; and, what is very remarkable, the males have four wings, but the females never have any. They all have long legs, not only to enable them to creep over the long hairs of plants and leaves, but also to travel from one tree to another, when they happen to stand at a distance. Their trunk or snout lies under their breast; and this they thrust into the pores of the plant to suck out the juice, for they do not gnaw them, like the caterpillar, but so hurt them by sucking, that the leaves become spotted, and as it were overrun with scabs; for which reason their edges always turn up towards the middle.

It has been said that these insects are often carried away and devoured by ants; but this Frysch, from whom this description is taken, could never observe. The ants, indeed, are fond of those trees where there is a great number of those insects: but then it is only to suck the juice which flows from the leaves that have been just wounded. This more particularly happens in the heat of summer, when other moisture is wanting; however, he never found them hurting or carrying away any of these insects while alive; nor

indeed were they able, for the leaf louse is more than a match for the ant at single combat. Whenever they perceive the ant approaching behind them, they kick back with their hinder feet, and thus drive off the invader, as a horse would a lion.

The three principal and constant enemies to these insects are, first, the fire-fly, which lays its eggs where these insects are in greatest number, which producing a worm, seizes and devours all the leaf lice that come near it; another enemy is the worm of a peculiar kind of beetle, which destroys them in great numbers; but the most formidable of all enemies is the ichneumon fly, that seizes upon one of the largest females, and laying its egg upon her, this is hatched into a worm, which soon devours and destroys the animal from whose body it springs.

CHAPTER VI.

OF THE BUG, ARD ITS VARIETIES.

The Bug is another of those nauseous insects that intrude upon the retreats of mankind, and that often banish that sleep, which even sorrow and anxiety permitted to approach. This, to many men, is, of all other insects, the most troublesome and obnoxious. The night is usually the season when the wretched have rest from their labour; but this seems the only season when the bug issues from its retreats to make its depredations. By day it lurks like a robber in the most secret parts of the bed, takes the advantage of every chink and cranny to make a secure lodgment, and contrives its habitation with so much art, that scarcely any industry can discover its retreat. It seems to avoid the light with great cunning; and even if candles be kept burning, this formidable insect will not issue from its hiding-place. But when darkness promises security, it then issues from every corner of the bed, drops from the tester, crawls from behind the arras, and travels with great assiduity to the unhappy patient, who vainly wishes for rest and refreshment. It is generally vain to destroy one only, as there are hundreds more to revenge their companion's fate; so that the person who thus is subject to be bitten, remains the whole night like a sentinel upon duty, rather watching the approach of fresh invaders, than inviting the pleasant approaches of sleep.

Nor are these insects less disagreeable from their nauseous stench, than their unceasing appetites.

When they begin to crawl, the whole bed is infected with the smell; but if they are accidentally killed, then it is insupportable.

These are a part of the inconveniencies that result from the persecution of these odious insects; but happily for Great Britain, they

multiply less in these islands than in any part of the continent. In France and Italy, the beds, particularly in their inns, swarm with them, and every piece of furniture seems to afford them a retreat. They grow larger also with them than with us, and bite with more cruel appetite.

This animal, if examined minutely, appears to consist of three principal parts, the head, the corslet, and the belly. It has two brown eyes, that are very small, and a little prominent, besides two feelers, with three joints; underneath these there is a crooked trunk, which is its instrument of torture, and which, when in motion, lies close upon the breast. The breast is a kind of ring, in which are placed the two first pair of legs. The belly consists of nine rings, under which are placed two pair of legs more, making six in all. Each leg has three joints, which form the thigh, the leg, and the foot, which is armed with a crooked claw, like a hook. The body is smooth, except a few short hairs, that may be seen by the microscope about the vent, and on the two last rings. Its motion is slow and unwieldy; yet its sight is so exquisite, that the instant it perceives the light it generally makes good its retreat, and they are seldom caught though the bed swarms with them.

If we examine this insect internally, we shall find the great artery, which in all insects performs the functions of the heart; we shall find the apertures of the lungs, on the right side and the left, through which the animal breathes; we shall find a stomach and intestines, which, as in other animals, run from the mouth to the anus. If the insect has been kept long fasting, there will be a mucus found in its body like the white of an egg; but if crushed after a full meal, the human blood which it has sucked in will appear a little darkened, by having passed through the insect's body.

The male and female of these animals are plainly distinguishable from each other, and the parts of generation are obvious enough. They are often found coupling tail to tail, and in this state are very easily destroyed. The female has an ovary filled with eggs, joined together like a bunch of grapes, each egg being oblong, almost cylindrical, inclining to white, and pretty transparent. In about two days after impregnation by the male, she deposits her eggs to the number of about a hundred and fifty, in some convenient place, where they are likely to receive no disturbance. There they continue for some months; during which time neither cold nor heat, neither moisture nor fumigation, can in the least retard their exclusion, but they come forth active and ready for mischief. It is this hardiness in the shell that seems to continue the breed, as the old ones die every winter, or are easily destroyed by any fumigation that is used for that purpose. But the eggs seem incapable of destruction; even those men who make a livelihood by killing these nauseous insects, though they can answer for the parent, can never be sure of the egg. For this reason they usually pay those houses to which they are called a second or a third visit, and at last exterminate them by perseverance.

The manner of destroying them seems rather the effects of assiduity than antidote; for the men called in upon this occasion take every part of the furniture asunder, brush every part of it with great assiduity, anoint it with a liquid, which I take to be a solution of corrosive sublimate, and having performed this operation twice or thrice, the vermin are most usually destroyed.

Cleanliness, therefore, seems to be the best antidote to remove these nauseous insects; and wherever that is wanting, their increase seems but a just punishment. Indeed, they are sometimes found in such numbers among old furniture, and neglected chambers exposed to the south, that, wanting other sustenance, they devour each other. They are also enemies to other vermin, and destroy fleas very effectually; so that we seldom have the double persecution of different vermin in the same bed. Of the bug kind Linnæus reckons up forty.

CHAPTER VII.

OF THE WOOD LOUSE, AND ITS VARIETIES.

The common Wood Louse is seldom above half an inch long, and a quarter of an inch broad. The colour is of a livid black, especially when found about dunghills, and on the ground; but those that are to be met with under tiles, and in drier places, are of the colour of the hair of an ass. It has fourteen feet, seven on each side; and they have only one joint each, which is scarcely perceivable. It has two short feelers, and the body is of an oval shape. When it is touched it rolls itself up into a sort of ball, and the sides near the feet are dentated like a saw. It is often found among rotten timber, and on decayed trees; in winter it lies hid in the crevices of walls and all sorts of buildings. The male is easily distinguishable from the female, being less, and more slender. The eggs they lay are white and shining, like seed pearls, and are very numerous: however, more properly speaking, although when excluded the young have all the appearance of an egg, yet they are alive, and, without throwing off any shell, stir and move about with great vivacity; so that this animal may properly be said to be viviparous. The little worms at first seem scarcely able to stir, but they soon feed and become very brisk. These animals are of great use in medicine, being impregnated with a saline quality, which is diuretic and stimulating. Of this insect Linnæus makes three species.

CHAPTER VIII.

OF THE MONOCULUS, OR ABORESCENT WATER FLEA.

THIS animal, which is of the size of the flea, appears to the sight, unassisted by the microscope, to have but one eye; for the eyes, by reason of the smallness of the head, seem to be joined to each other; they are situated in the trunk of this insect, and the beak is likewise very small and sharp pointed. The structure of the eye is seen, by the microscope, to be reticulated, or made like a net; and the trunk of this insect, by which it feeds, is not only small and sharp, but also transparent. The insects are of a blood-red colour; and sometimes are seen in such multitudes on the surface of standing water, as to make them appear all over red, whence many fanciful people have thought the water to be turned into blood.

Swammerdam tells us of a celebrated professor of Leyden, who was at first astonished by an appearance of this kind. Being once intent upon his studies, he heard a noise, of which, as it increased by degrees, he was desirous to know the cause. The maid-servant attending to his summons, appeared quite petrified with fear, and told him, with a tremulous voice, that all the waters of Leyden were turned into blood. Upon this he went directly in a small bark to the place where the water was thus changed, and put some of the bloody water into a glass; but upon viewing it with attention, he observed that it abounded with infinite numbers of these little red insects, which tinged the whole body of the fluid with that seemingly formidable colour. Thus his sudden fright was changed into lasting admiration.

Of all parts of this animal, its branching arms, and the motion it makes with them in the water, deserve our greatest attention. By these the little creature can move in a straight line; waving its arms, as a bird does its wings in the air, sometimes upward, sometimes downward, sometimes to the right, sometimes to the left, yet still continuing to proceed in a right line. By striking the water with its arms, it can ascend with great velocity; and by striking in a contrary direction, it dives with equal ease. As these motions are very rapid, the little animal appears to jump in the water, its head always tending to the surface, and its tail stretched downward. This insect is produced from an egg, which, when excluded, is carried on the back of the female, and soon is seen floating in the water round her. Its appearance at first is that of a very small whitish insect, endued with a very nimble motion. Except in colour it suffers no change, only continuing to grow larger and redder as it grows old. They sometimes remain several days on the surface of the water, and sometimes are seen at the bottom only; but they are never at rest. They change their skin, like most other insects; and the cast skin resembles the insect itself so exactly, that one might mistake the mask for the animal.

CHAPTER IX.

OF THE SCORPION, AND ITS VARIETIES.

THERE is scarcely an insect without wings that is not obnoxious to man: the smallest have the power of annoying him, either by biting or stinging him; and though each is in itself contemptible, they become formidable from their numbers. But of all this class, there is none so terrible as the Scorpion, whose shape is hideous, whose size among the insect tribe is enormous, and whose sting is generally fatal. Happy for England, the scorpion is entirely a stranger among us! In several parts of the continent of Europe it is but too well known, though it seldom grows above four inches long; but in the warm tropical climates it is seen a foot in length, and in every respect as large as a lobster.

The scorpion is one of the largest of the insect tribe, and not less terrible from its size than its malignity. It resembles a lobster somewhat in shape, but is infinitely more hideous. There have been enumerated nine different kinds of this dangerous insect, chiefly distinguished by their colour; there being scorpions yellow, brown and ash-coloured; others that are the colour of rusty iron, green, pale yellow, black, claret-colour, white, and grey.

There are four principal parts distinguishable in this animal; the head, the breast, the belly, and the tail. The scorpion's head seems, as it were, jointed to the breast; in the middle are seen two eyes, and, a little more forward, two eyes more, placed in the fore part of the head; these eyes are so small that they are scarcely perceivable, and it is probable the animal has but little occasion for seeing. The mouth is furnished with two jaws; the undermost is divided into two, and the parts notched into each other, which serves the animal as teeth, and with which it breaks its food, and thrusts it into its mouth: these the scorpion can at pleasure pull back into its mouth, so that no part of them can be seen. On each side of the head are two arms, each composed of four joints; the last of which is large, with strong muscles, and made in the manner of a lobster's claw. Below the breast are eight articulated legs, each divided into six joints; the two hindmost of which are each provided with two crooked claws, and here and there covered with hair. The belly is divided into seven little rings; from the lowest of which is continued a tail, composed of six joints, which are bristly, and formed like little globes, the last being armed with a crooked sting. This is that fatal instrument which renders this insect so formidable: it is long, pointed, hard, and hollow; it is pierced near the base by two small holes, through which, when the animal stings, it ejects a drop of poison, which is white, caustic, and fatal. The reservoir in which this poison is kept, is in a small bladder near the tail, into which the venom is distilled by a peculiar apparatus. If this bladder be gently

pressed, the venom will be seen issuing out through the two holes above mentioned; so that it appears that when the animal stings, the bladder is pressed, and the venom issues through the two apertures into the wound.

There are few animals more formidable, or more truly mischievous, than the scorpion. As it takes refuge in a small place, and is generally found sheltering in houses, so it cannot be otherwise than that it must frequently sting those among whom it resides. In some of the towns of Italy, and in France, in the province of Languedoc, it is one of the greatest pests that torment mankind; but its malignity in Europe is trifling when compared to what the natives of Africa and the East are known to experience. In Batavia, where they grow twelve inches long, there is no removing any piece of furniture, without the utmost danger of being stung by them. Bosman assures us, that along the Gold Coast they are often found larger than a lobster, and that their sting is inevitably fatal. In Europe, however, they are by no means so large, so venomous, or so plentiful. The general size of this animal does not exceed two or three inches, and its sting is very seldom found to be fatal. Maupertuis, who made several experiments on the scorpion of Languedoc, found it by no means so invariably dangerous as had till then been represented. He provoked one of them to sting a dog, in three places of the belly, where the animal was without hair. In about an hour after the poor animal seemed greatly swoln, and became very sick: he then cast up whatever he had in his bowels, and for about three hours continued vomiting a whitish liquid. The belly was always greatly swoln when the animal began to vomit, but this operation always seemed to abate the swelling; which alternately swelled, and was thus emptied, for three hours successively. The poor animal, after this, fell into convulsions, bit the ground, dragged himself along upon his fore-feet, and at last died, five hours after being bitten. He was not partially swoln round the place which was bitten, as is usual after the sting of a wasp or a bee, but his whole body was inflated, and there only appeared a red spot on the places where he had been stung.

Some days after, however, the same experiment was tried upon another dog, and even with more aggravated cruelty; yet the dog seemed no way affected by the wounds, but howling a little when he received them, continued alert and well after them; and soon after was set at liberty, without showing the smallest symptoms of pain. So far was this poor creature from being terrified at the experiment, that he left his own master's house to come to that of the philosopher, where he had received more plentiful entertainment. The same experiment was tried by fresh scorpions, upon seven other dogs, and upon three hens; but not the smallest deadly symptom was seen to ensue. From hence it appears, that many circumstances, which are utterly unknown, must contribute to give efficacy to the scorpion's venom. Whether its food, long fasting, the season, the nature of the vessels it wounds, or its state

of maturity, contribute to or retard its malignity, is yet to be ascertained by succeeding experiment. In the trials made by our philosopher, he employed scorpions of both sexes, newly caught, and seemingly vigorous and active. The success of this experiment may serve to show, that many of those boasted antidotes which are given for the cure of the scorpion's sting, owe their success rather to accident than their own efficacy. They only happened to cure, when their sting was no way dangerous; but in cases of actual malignity, they might probably be utterly unserviceable.

The scorpion of the tropical climates being much larger than the former, is probably much more venomous. Helbigius, however, who resided for many years in the East, assures us, that he was often stung by the scorpion, and never received any material injury from the wound; a painful tumour generally ensued, but he always cured it by rubbing the part with a piece of iron or stone, as he had seen the Indians practise before him, until the flesh became insensible. Seba, Moore, and Bosman, however, give a very different account of the scorpion's malignity, and assert, that unless speedily relieved, the wound becomes fatal.

It is certain that no animal in the creation seems endued with such an irascible nature. I have often seen them taken and put into a place of security, exerting all their rage against the sides of the glass vessel that contained them. I have seen them attempt to sting a stick, when put near them; and attack a mouse or a frog, while those animals were far from offering any injury. Maupertuis put three scorpions and a mouse into the same vessel together, and they soon stung the little animal in different places. The mouse, thus assaulted, stood for some time upon the defensive, and at last killed them all, one after another. He tried this experiment, in order to see whether the mouse, after it had killed, would eat large scorpions; but the little quadruped seemed entirely satisfied with the victory, and even survived the severity of the wounds it had received. Wolkamer tried the courage of the scorpion against the large spider, and enclosed several of both kinds in glass vessels for that purpose.* The success of this combat was very remarkable. The spider at first used all its efforts to immesh the scorpion in its web, which it immediately began spinning; but the scorpion rescued itself from the danger, by stinging its adversary to death: it soon after cut off, with its claws, all the legs of the spider, and then sucked all the internal parts at its leisure. If the scorpion's skin had not been so hard, Wolkamer is of opinion that the spider would have obtained the victory; for he had often seen one of these spiders destroy a toad.

The fierce spirit of this animal is equally dangerous to its own species; for scorpions are the cruellest enemies to each other. Maupertuis put about a hundred of them together in the same

* Ephemerides, Dec. 2, 1687. Observ. 224.

glass; and they scarcely came into contact, when they began to exert all their rage in mutual destruction: there was nothing to be seen but one universal carnage, without any distinction of age or sex; so that, in a few days, there remained only fourteen, which had killed and devoured all the rest.

But their unnatural malignity is still more apparent in their cruelty to their offspring. He enclosed a female scorpion, big with young, in a glass vessel, and she was seen to devour them as fast as they were excluded: there was but one only of the number that escaped the general destruction, by taking refuge on the back of its parent; and this soon after revenged the cause of its brethren, by killing the old one in its turn.

Such is the terrible and unrelenting nature of this insect, which neither the bonds of society nor of nature can reclaim: it is even asserted, that when driven to an extremity, the scorpion will often destroy itself. The following experiment was ineffectually tried by Maupertuis; but I am so well assured of it by many eye-witnesses, who have seen it both in Italy and America, that I have no doubt remaining of its veracity. A scorpion, newly caught, is placed in the midst of a circle of burning charcoal, and thus an egress prevented on every side: the scorpion, as I am assured, runs for about a minute round the circle, in hopes of escaping, but finding that impossible, it stings itself on the back of the head, and in this manner the undaunted suicide instantly expires.

It is happy for mankind that these animals are thus destructive to each other, since otherwise they would multiply in so great a degree as to render some countries uninhabitable. The male and female of this insect are very easily distinguishable, the male being smaller and less hairy. The female brings forth her young alive, and perfect in their kind. Redi having bought a quantity of scorpions, selected the females, which by their size and roughness were easily distinguishable from the rest, and putting them in separate glass vessels, he kept them for some days without food. In about five days one of them brought forth thirty-eight young ones, well shaped, and of a milk-white colour, which changed every day more and more into a dark rusty hue. Another female, in a different vessel, brought forth twenty-seven of the same colour; and the day following the young ones seemed all fixed to the back and belly of the female. For near a fortnight all these continued alive and well; but afterwards some of them died daily, until, in about a month, they all died except two.

Were it worth the trouble, these animals might be kept living as long as curiosity should think proper. Their chief food is worms and insects, and upon a proper supply of these, their lives might be lengthened to their natural extent. How long that may be we are not told: but if we may argue from analogy, it cannot be less than seven or eight years, and, perhaps, in the larger kind, double that duration. As they have somewhat the form of the lobster, so they resemble that animal in casting their shell, or more

properly their skin, since it is softer by far than the covering of the lobster, and set with hairs, which grow from it in great abundance, particularly at the joinings. The young lie in the womb of the parent, each covered up in his own membrane, to the number of forty or fifty, and united to each other by an oblong thread, so as to exhibit altogether the form of a chaplet.

Such is the manner in which the common scorpion produces its young; but there is a scorpion of America produced from the egg in the manner of the spider. The eggs are no larger than pin points, and they are deposited in a web, which they spin from their bodies, and carry about with them, till they are hatched. As soon as the young ones are excluded from the shell, they get upon the back of the parent, who turns her tail over them, and defends them with her sting. It seems probable, therefore, that captivity produces that unnatural disposition in the scorpion which induces it to destroy its young, since, at liberty, it is found to protect them with such unceasing assiduity.

CHAPTER X.

OF THE SCOLOPENDRA AND GALLY-WORM.

Of these hideous and angry insects, we know little, except the figure and the noxious qualities. Though with us there are insects somewhat resembling them in form, we are placed at a happy distance from such as are really formidable. With us they seldom grow above an inch long; in the tropical climates they are often found above a quarter of a yard.

The Scolopendra is otherwise called the Centipes, from the number of its feet; and it is very common in many parts of the world, especially between the tropics. Those of the East Indies, where they grow to the largest size, are about six inches long, of a ruddy colour, and as thick as a man's finger; they consist of many joints, and from each joint is a leg on each side; they are covered with hair, and seem to have no eyes; but there are two feelers on the head, which they make use of to find out the way they are to pass; the head is very round, with two small sharp teeth, with which they inflict wounds that are very painful and dangerous. A sailor that was bit by one on board a ship, felt an excessive pain, and his life was supposed to be in danger; however, he recovered by the application of three roasted onions to the part, and was soon quite well. Of this animal there are different kinds; some living like worms, in holes in the earth, others under stones, and among rotten wood; so that nothing is more dangerous than removing those substances, in the places where they breed.

The Gally-Worm differs from the scolopendra, in having double the number of feet, there being two on each side to every joint of

the body. Some of these are smooth, and others hairy; some are yellow, some black, and some brown. They are found among decayed trees, between the wood and the bark; as also among stones that are covered with moss. They all, when touched, contract themselves, rolling themselves up like a ball. Whatever may be their qualities in the tropical parts of the world, in Europe they are perfectly harmless; having been often handled and irritated, without any vindictive consequences.

All these, as well as the scorpion, are supposed to be produced perfect from the parent, or the egg, and to undergo no changes after their first exclusion. They are seen of all sizes; and this is a sufficient inducement to suppose that they preserve their first appearance through the whole of their existence. It is probable, however, that, like most of this class, they often change their skins; but of this we have no certain information.

CHAPTER XI.

OF THE LEECH.

The last of this wingless tribe that I shall mention is the Leech, which, like all the former, undergoes no varieties of transformation, but when once excluded from the body of the parent, preserves its first figure to the end. I place the history of the leech among the first class of animals, while I have degraded the Earth-worm, the Tænia, and the Polypus, into the class of zoophytes, or that imperfect tribe which serves to make the shade between animal and vegetable nature. Not but that the earth-worm or the polypus have their motions, their appetites, and their vital principles, as complete as the leech, and to a cursory view appear every way as complete animals. But there is one circumstance that lays the line between them, that exalts the one and degrades the other. The earth-worm and the polypus may be cut in two pieces, and each piece will produce a new and perfect animal; the leech cannot suffer this dissection, but dies when cut in two—an evident instance that it is possessed of a more perfect organization than those animals, which it otherwise very much resembles.

The leech, from its uses in medicine, is one of those insects that man has taken care to provide; but, of a great variety, one kind only is considered as serviceable. The Horse-Leech, which is the largest of all, and grows to four inches in length, with a glossy black surface, is of no use, as it will not stick to the skin; the Snail-Leech is but an inch in length, and though it will stick, is not large enough to extract a sufficient quantity of blood from the patient; the Broad-tailed Leech, which grows to an inch and a half in length, with the back raised into a sort of ridge, will

stick but on very few occasions; it is the large Brown Leech, with a whitish belly, that is made use of in medicine, and whose history best merits our curiosity.

The leech has the general figure of a worm, and is about as long as one's middle finger. Its skin is composed of rings, by means of which it is posseseed of its agility, and swims in water. It contracts itself when out of water in such a manner, that when touched it is not above an inch long. It has a small head, and a black skin, edged with a yellow line on each side, with some yellowish spots on the back. The belly also, which is of a reddish colour, is marked with whitish-yellow spots. But the most remarkable part of this animal is the mouth, which is composed of two lips, that take whatever form the insect finds convenient. When at rest, the opening is usually triangular; and within it are placed three very sharp teeth, capable of piercing not only the human skin, but also that of a horse or an ox. Still deeper in the head is discovered the tongue, which is composed of a strong fleshy substance, and which serves to assist the animal in sucking when it has inflicted its triple wound; for no sooner is this voracious creature applied to the skin than it buries its teeth therein, then closes its lips round the wound which it has made, and thus, in the manner of a cupping-glass, extracts the blood as it flows to the different orifices.

In examining this animal's form farther towards the tail, it is seen to have a gullet and an intestinal canal, into which the blood flows in great abundance. On each side of this are seen running along several bladders, which, when the animal is empty, seem to be filled with nothing but water; but when it is gorging blood, they seem to communicate with the intestines, and receive a large portion of the blood which flows into the body. If these bladders should be considered as so many stomachs, then every leech will be found to have twenty-four. But what is most extraordinary of all in this animal's formation is, that though it takes so large a quantity of food, it has no anus or passage to eject it from the body when it has been digested. On the contrary, the blood which the leech has thus sucked remains for several months clotted within its body, blackened a little by the change, but no way putrefied, and very little altered in its texture or consistence. In what manner it passes through the animal's body, or how it contributes to its nourishment, is not easily accounted for. The water in which they are kept is very little discoloured by their continuance; they cannot be supposed to return the blood by the same passage through which it was taken in; it only remains, therefore, that it goes off through the pores of the body, and that these are sufficiently large to permit its exclusion.

But it is not in this instance alone that the leech differs from all other insects. It was remarked in a former chapter, that the whole insect tribe had the opening into their lungs placed in their sides, and that they breathed through those apertures as other animals

through the mouth. A drop of oil poured on the sides of a wasp, a bee, or a worm, would quickly suffocate them, by stopping up the passages through which they breathe; but it is otherwise with the leech, for this animal may be immersed in oil without injury; nay, it will live therein, and the only damage it will sustain is, that when taken out it will be seen to cast a fine pellucid skin, exactly of the shape of the animal, after which it is as alert and vigorous as before. It appears from hence that the leech breathes through the mouth; and in fact it has a motion that seems to resemble the act of respiration in more perfect animals; but concerning all this we are very much in the dark.

This animal seems to differ from all others in several respects; the rest of the reptile tribe are brought forth from eggs, the leech is viviparous, and produces its young, one after the other, to the number of forty or fifty at a birth. It is probable that, like the snail, each insect contains the two sexes, and that it impregnates and is impregnated in the same manner. The young ones are chiefly found in the month of July in shallow running waters, and particularly where they are tepified by the rays of the sun. The large ones are chiefly sought after; and being put into a glass vessel filled with water, they remain for months, nay, for years, without taking any other subsistence. But they never breed in this confinement; and, consequently, what regards that part of their history still remains obscure.

In this part of the world they seldom grow to above four inches, but in America and the East they are found from six to seven. Their pools there abound with them in such numbers, that it would be dangerous bathing there, if for no other consideration. Our sailors and soldiers, who the last war were obliged to walk in those countries through marshy grounds, talk with terror of the number of leeches that infested them on their march. Even in some parts of Europe they increase so as to become formidable. Sedelius, a German physician, relates, that a girl of nine years old, who was keeping sheep near the city of Bomst in Poland, perceiving a soldier making up to her, went to hide herself in a neighbouring marsh among some bushes; but the number of leeches was so great in that place, and they stuck to her so close, that the poor creature expired from the quantity of blood which she lost by their united efforts. Nor is this much to be wondered at, since one of those insects that, when empty, generally weighs but a scruple, will, when gorged, weigh more than two drachms.

When leeches are to be applied, the best way is to take them from the water in which they are contained about an hour before, for they thus become voracious, and fasten more readily. When saturated with blood, they generally fall off of themselves; but if it be thought necessary to take them from the wound, care should be used to pull them very gently, or even to sprinkle them with

salt if they continue to adhere; for if they be plucked rudely away, it most frequently happens that they leave their teeth in the wound, which makes a very troublesome inflammation, and is often attended with danger. If they be slow in fixing to the part, they are often enticed by rubbing it with milk, or blood, or water mixed with sugar. As salt is a poison to most insects, many people throw it upon the leech when it has dropped from the wound, by which means it disgorges the blood it has swallowed, and it is then kept for repeated application. They seldom, however, stick after this operation; and as the price is but small, fresh leeches should always be applied whenever such an application is thought necessary.

PART II.

INSECTS OF THE SECOND ORDER.

CHAPTER I.

OF THE SECOND ORDER OF INSECTS IN GENERAL.

In the former part we gave a concise history of the most considerable insects that, without wings, were produced in a perfect state; either from the body of the parent alive, like quadrupeds, or from the egg, in the manner of birds. We come now to a second order of insects, that are produced from the egg, like the former, but not in a perfect state; for when first excluded they are without wings. This, however, does not hinder the exercise of their animal functions; the insect, although not yet come to perfection, walks, leaps, and eats; nor is it ever deprived of motion, only that it rests a little when it is about to cast that part of its skin previous to its state of perfection. It is then seen to assume two wings, which, like a budding flower, burst through the case that contained them, and the animal becomes a winged insect in its state of highest perfection. To this order we may refer the Libella or Dragon-Fly, the Formica Leo or Lion-Ant, the Grasshopper, the Locust, the Cricket, the Wood-Cricket, the Mole-Cricket, the Flea-Locust, the Flying-Bug, the Tipula, the Water-Scorpion, the Notonecta or Water-Fly, and many others.

CHAPTER II.

OF THE LIBELLA, OR DRAGON-FLY.

Of all the flies which adorn or diversify the face of nature, these are the most various and the most beautiful: they are of all colours—green, blue, crimson, scarlet, white; some unite a variety of the most vivid tints, and exhibit in one animal more different shades than are to be found in the rainbow. They are called, in different parts of the kingdom, by different names; but none can be at a loss to know them, as they are distinguished from all other flies, by the length of their bodies, by the largeness of their eyes, and the beautiful transparency of their wings, which are four in number. They are seen in summer flying with great rapidity near every hedge, and by every running brook; they sometimes settle on the leaves of plants, and sometimes keep for hours together on the wing.

Dragon-flies, though there are three or four different kinds, yet agree in the most striking parts of their history, and one account may serve for all. The largest sort are generally found from two to three inches long; their tail is forked; their body divided into eleven rings; their eyes are large, horny, and transparent, divided by a number of intersections; and their wings, that always lie flat when they are at rest, are of a beautiful glossy transparency, sometimes shining like silver, and sometimes glistening like gold. Within the mouth are to be seen two teeth covered with a beautiful lip: with these the creatures bite fiercely when they are taken; but their bite is perfectly harmless, as I have experienced more than once.

These insects, beautiful as they are, are produced from eggs, which are deposited in the water, where they remain for some time without seeming life or motion. They are ejected by the female into the water in clusters, like a bunch of grapes, where they sink to the bottom by their natural weight, and continue in that state till the young ones find strength enough to break the shell, and to separate from each other. The form in which they first show life is that of a worm with six legs, bearing a strong resemblance to the dragon-fly in its winged state, except that the wings are yet concealed within a sheath peculiar to this animal. The rudiments of these appear in bunches on the back, within which the wings are folded up into each other, while all the colours and varieties of painting appear transparent through the skin. These animals, upon quitting the egg, still continue in the water, where they creep and swim, but do not move swiftly. They have likewise a sharp sight, and immediately sink to the bottom if any one comes to the places wherein they live, or whenever they perceive the least uncommon object. Their food at that time is soft mud, and the glutinous earthy substances that are found at the bottom.

When these animals prepare to change from their reptile to their flying state, they then move out of the water to a dry place, as into grass, to pieces of wood, stone, or any thing else they meet with. They there firmly fix their acute claws, and for a short time continue quite immoveable, as if meditating on the change they are to undergo. It is then observed, that the skin first opens on the head and back; and out of this opening they exhibit their real head and eyes, and at length their six legs; whilst, in the mean time, the hollow and empty skin, or slough, of their legs, remains firmly fixed in its place. After this, the enclosed creature creeps forward by degrees; and by this means draws first its wings, and then its body out of the skin; and proceeding a little farther, sits at rest for some time, as if immoveable. During this time, the wings, which were moist and folded, begin by degrees to expand themselves, and to make smooth and even all those plaits which were laid against each other like a closed fan. The body is likewise insensibly extended, until all the limbs have obtained their proper size and dimensions. All these surprising and difficult operations are accomplished by the force of the blood and the circulating humours. The creature cannot at first make use of its new wings, and therefore is forced to stay in the same place until all its limbs are dried by the circumambient air. It soon, however, begins to enter upon a more noble life than it had hitherto led in the bottom of the brook; and from creeping slowly and living accidentally, it now wings the air, and makes choice from amidst the variety of its provisions.

Indeed, no animal is more amply fitted for motion, subsistence, and enjoyment. As it haunts and seeks after its food flying in the air, nature has provided it with two large eyes, which make almost the whole head, and which resemble glittering mother-of-pearl. It has also four expansive silver-coloured wings, with which, as with oars, it can turn itself with prodigious velocity; and to assist these it is furnished with a very long body, which, like a rudder, directs its motions. As the wings are long, and the legs short, they seldom walk, but are ever seen either resting or flying. For this reason, they always choose dry branches of trees or shrubs to remain on; and when they have refreshed themselves a little, they renew their flight. Thus they are seen adorning the summer with a profusion of beauty, lightly traversing the air in a thousand directions, and expanding the most beautiful colours to the sun. The garden, the forest, the hedges, and the rivulets, are animated by their sports; and there are few who have been brought up in the country, who have not employed a part of their childhood in the pursuit.

But while these beautiful flies appear to us so idly and innocently employed, they are, in fact, the greatest tyrants of the insect tribe, and, like the hawk among birds, are only hovering up and down to seize their prey. They are the strongest and the most courageous of all winged insects; nor is there one, how large

soever, that they will not attack and devour. The blue fly, the bee, the wasp, and the hornet, make their constant prey; and even the butterfly, that spreads so large a wing, is often caught, and treated without mercy. Their appetite seems to know no bounds; they spend the whole day in the pursuit, and have been seen to devour three times their own size in the capture of a single hour. They seize their prey flying with their six claws, and tear it easily to pieces with their teeth, which are capable of inflicting troublesome wounds.

But the males are upon the wing for another purpose beside that of food, as they are very salacious, and seek the females with great ardour. The sun no sooner begins to warm the fields, than the males are found assiduously employed each in seeking its mate; and no sooner does a female appear, but two or three males are seen pursuing and endeavouring to seize her with all their arts and agility. The instrument of generation in the male is placed very different from that of any other insect, being not at the end of the tail as in others, but immediately under the breast, and consequently, at first view, incapable of being united to the sexual part of the female, which, as in other insects, lies in the tail. To perform this junction, nature has provided the male with a very peculiar manner of proceeding. As soon as he perceives the female, and finds himself sufficiently near, he seizes upon the back of her head by surprise, and fastening his claws upon her, turns round his forky tail, which he fastens round her neck; and in this manner fixes himself so closely and firmly, that no efforts can remove him. It is in vain that she flies from one branch to another and settles upon them, he still keeps fixed, and often continues in this situation for three or four hours successively. When he flies, she is obliged to fly with him; but he still directs the way, and though she moves her wings, she seems entirely guided by his motions. As yet, however, the business of impregnation is not performed, for to this the female must contribute; and she at last seems, by the continuance of her constraint, to comply: for, turning up the end of her tail to that part of the breast of the male in which lies the part proper for generation, both instruments meet, and the eggs of the female receive the necessary fecundation. An hour or two after this she flies to some neighbouring pool, where she deposits her eggs, as was already mentioned. There they continue in a reptile state for a year, and then are changed into a beautiful fly, resembling the parent.

CHAPTER III.

OF THE FORMICA LEO, OR LION-ANT.

ALTHOUGH this animal properly belongs to no order of insects, yet, as it is changed into a fly very much resembling that described in the preceding chapter, it may not be improper to give its history here. If we consider the life of this animal in its different stages of existence, we shall find it equally wonderful in all; but as it changes to a dragon-fly, what we have said of that animal above need not be repeated here. The Lion-Ant, when it becomes an inhabitant of air, in every respect resembles that which has been already described; its glossy wings, its voracious appetites, its peculiar manner of generation, are entirely the same. It is in its reptile state that it differs from all other insects; and in that state it will be amusing to pursue its history.

The lion-ant, in its reptile state, is of the size of a common wood-louse, but somewhat broader. It has a pretty long head and a roundish body, which becomes a little narrower towards the tail. The colour is a dirty grey, speckled with black, and the body is composed of several flat rings, which slip one upon another. It has six feet, four of which are fixed to the breast and two to the neck. The head is small and flat, and before there are two little smooth horns or feelers, which are hard, about a quarter of an inch long, and crooked at the ends. At the basis of the feelers there are two small black lively eyes, by which it can see the smallest object, as is easily discovered by its starting from every thing that approaches.

To a form so unpromising, and so ill provided for the purposes of rapacity, this animal unites the most ravenous appetites in nature; but to mark its imbecility still stronger, as other animals have wings or feet to enable them to advance towards their prey, the lion-ant is unprovided with such assistance from either. It has legs indeed; but these only enable it to run backward, so that it could as soon die as make the smallest progressive motion. Thus, famished and rapacious as it ever seems, its prey must come to it, or rather into the snare provided for it, or the insidious assassin must starve.

But nature, that has denied it strength or swiftness, has given it an equivalent in cunning, so that no animal fares more sumptuously, without ever stirring from its retreat. For this purpose, it chooses a dry sandy place, at the foot of a wall, or under some shelter, in order to preserve its machinations from the rain. The driest and most sandy spot is the most proper for it; because a heavy clogged earth would defeat its labour. When it goes about to dig the hole where it takes its prey, it begins to bend the hinder part of its body, which is pointed, and thus works backward; making, after several attempts, a circular furrow, which serves to

mark out the size of the hole it intends making, as the ancients marked out the limits of a city with a plough. Within this first furrow it digs a second, then a third, and afterwards others, which are always less than the preceding. Then it begins to deepen its hole, sinking lower and lower into the sand, which it throws with its horns, or feelers, towards the edges, as we see men throw up sand in a gravel-pit. Thus, by repeating its labours all round, the sand is thrown up in a circle about the edges of the pit, until the whole is quite completed. This hole is always formed in a perfect circle; and the pit itself resembles the inside of an inverted funnel. When this insect first leaves the egg and is newly hatched, the first pit it makes is very small; but as it grows bigger, it makes a larger hole, which is destined, like a pit-fall, to entrap its prey. It is generally about two inches deep, and as much in diameter.

The work being thus with great labour finished, the insidious insect places itself in ambush, hiding itself at the bottom under the sand, in such a manner that its horns encircle the bottom of the pit. All the sides of this pit-fall are made of the most loose and crumbling materials, so that scarce any insect can climb up that has once got down to the bottom. Conscious of this, the lion-ant remains in patient expectation, ready to profit by that accident which throws some heedless little animal into its den. If then, by misfortune, an ant, a wood-louse, or a small caterpillar, walks too near the edge of the precipice, the sand gives way beneath them, and they fall to the bottom of the pit, where they meet inevitable destruction. The fall of a single grain of sand gives the murderer notice at the bottom of its cave, and it never fails to sally forth to seize upon its prey. It happens sometimes, however, that the ant or the wood-louse is too nimble, and runs up the sides of the pit-fall before the other can make ready to seize it. The lion-ant has then another contrivance, still more wonderful than the former; for, by means of its broad head and feelers, it has a method of throwing up a shower of sand, which falls upon the struggling captive with tremendous weight, and once more crushes it down to the bottom. When the insect is once fallen thus low, no efforts can retrieve or release it; the lion-ant seizes it with its feelers, which are hollow, and darting them both into its body, sucks out all the little animal's juices with the utmost rapacity.

When the prey is thus reduced to a husk, and nothing but the external form remains, the next care of the murderer is to remove the body from its cell; since the appearance of dead carcases might forewarn other insects of the danger of the place. The insect, therefore, takes up the wasted trunk with its feelers, and throws it with wonderful strength at least six inches from the edge of its hole; and then patiently sets about mending the breaches which its fortifications had received in the last engagement. Nothing can abate its industry, its vigilance, its patience, or its rapacity. It

will work for a week together to make its pit-fall; it will continue upon the watch for more than a month, patiently expecting the approach of its prey; and if it comes in greater quantities than is needful, yet still the little voracious creature will quit the insect it has newly killed, and leave it half eaten, to kill and attack any other that happens to fall within the sphere of its malignity. Though so voracious, it is surprisingly patient of hunger, some of them having been kept in a box with sand for six months and upwards, without feeding at all.

When the lion-ant attains a certain age, in which it is to change into another form, it then leaves off its usual rapacious habits, but keeps on its industry. It no longer continues to make pits, but furrows up the sand all round in an irregular manner, testifying those workings and violent agitations which most insects exhibit previous to their transformation. These animals are produced in autumn, and generally live a year, and perhaps two, before they assume a winged form. Certain it is, that they are found at the end of winter of all sizes; and it would seem that many of the smaller kinds had not yet attained sufficient maturity for transformation. Be this as it may, when the time of change approaches, if the insect finds its little cell convenient, it seeks no other; if it is obliged to remove, after furrowing up the sand, it hides itself under it, horns and all. It there spins a thread, in the manner of the spider, which being made of a glutinous substance, and being humid from the moisture of the body, sticks to the little particles of sand among which it is spun; and in proportion as it is thus excluded, the insect rolls up its web, sand and all, into a ball, of which itself is the centre. This ball is about half an inch in diameter, and within it the insect resides, in an apartment sufficiently spacious for all its motions. The outside is composed of sand and silk; the inside is lined with silk only, of a fine pearl colour, extremely delicate, and perfectly beautiful. But though the work is so curious within, it exhibits nothing to external appearance but a lump of sand; and thus escapes the search of birds, that might otherwise disturb the inhabitant within.

The insect continues thus shut up for six weeks or two months, and gradually parts with its eyes, its feelers, its feet, and its skin, all which are thrust into a corner of the inner apartment like a rag. The insect then appears almost in its winged state, except that there is a thin skin which wraps up the wings, and that appears to be nothing else but a liquor dried on their outside. Still, however, the little animal is too delicate and tender to venture from its retreat, but continues enclosed for some time longer: at length, when the members of this new insect have acquired the necessary consistence and vigour, it tears open its lodging, and breaks through its wall. For this purpose it has two teeth, like those of grasshoppers, with which it eats through, and enlarges the opening, till it gets out. Its body, which is turned like a screw, takes up no more than the space of a quarter of an inch,

but when it is unfolded, it becomes half an inch in length; while its wings, that seemed to occupy the smallest space, in two minutes' time unfold, and become longer than the body. In short, it becomes a large and beautiful fly of the libellula kind, with a long slender body of a brown colour, a small head and large bright eyes, long slender legs, and four large transparent reticulated wings. The rest of its habits resemble that insect whose form it bears, except that, instead of dropping its eggs in the water, it deposits them in sand, where they are soon hatched into that rapacious insect so justly admired for its method of catching its prey.

CHAPTER IV.

OF THE GRASSHOPPER, THE LOCUST, THE CICADA, THE CRICKET, AND THE MOLE-CRICKET.

BELONGING to the second order of insects, we find a tribe of little animals, which though differing in size and colour, strongly resemble each other in figure, appetites, nature, and transformation. But though they all appear of one family, yet men have been taught to hold them in different estimation; for while some of this tribe amuse him with their chirpings, and banish solitude from the fields, others come in swarms, eat up every thing that is green, and in a single night convert the most delightful landscape into a dreary waste. However, if these animals be separately considered, the devouring locust is not in the least more mischievous than the musical grasshopper; the only difference is, that one species comes for food in a swarm, and the other feeds singly.

That animal which is called the Grasshopper with us, differs greatly from the cicada of antiquity; for as our insect is active enough in hopping through the long grass, from whence it has taken its name, the cicada had not this power, but either walked or flew. The little hissing note also of our grasshopper is very different from the song of the cicada, which was louder and far more musical. The manner in which this note is produced by the two animals is very different; for the cicada makes it by a kind of buckler, which the male has beneath its belly; the grasshopper by a transparent membrane that covers a hole at the base of its wings. There is still a greater variety in all these with regard to shape and colour. Some are green, some black, some livid, and some variegated; but many of them do not show all their colours till they fly. Some have long legs, some short, some with more joints, others with fewer. Some sing, others are mute; some are innocent, doing no damage to the husbandman, while others do such prodigious mischief, that they are looked upon in some countries as one of the terrible scourges of the incensed Divinity.

Of this variegated tribe, the little grasshopper that breeds in such plenty in every meadow, and continues its chirping through the summer, is best known to us, and by having its history we shall be possessed of that of all the rest. This animal is of the colour of green leaves, except a line of brown which streaks the back, and two pale lines under the belly and behind the legs. It may be divided into the head, the corslet, and the belly. The head is oblong, regarding the earth, and bearing some resemblance to that of a horse. Its mouth is covered by a kind of round buckler jutting over it, and armed with teeth of a brown colour, hooked at the points. Within the mouth is perceivable a large reddish tongue, and fixed to the lower jaw. The feelers or horns are very long, tapering off to a point; and the eyes are like two black specks, a little prominent. The corslet is elevated, narrow, armed above and below by two serrated spines. The back is armed with a strong buckler, to which the muscles of the legs are firmly bound, and round these muscles are seen the vessels by which the animal breathes, as white as snow. The last pair of legs are much longer and stronger than the first two pair, fortified by thick muscles, and very well formed for leaping. It has four wings; the anterior ones springing from the second pair of legs, the posterior from the third pair. The hinder wings are much finer and more expansive than the foremost, and are the principal instruments of its flight. The belly is considerably large, composed of eight rings, and terminated by a forky tail, covered with down, like the tail of a rat. When examined internally, besides the gullet, we discover a small stomach; aud behind that a very large one, wrinkled and furrowed withinside: lower down there is still a third; so that it is not without reason that all the animals of this order are said to chew the cud, as they so much resemble ruminating animals in their internal conformation.

A short time after the grasshopper assumes its wings, it fills the meadow with its note; which, like that among birds, is a call to courtship. The male only of this tribe is vocal; and upon examining at the base of the wings, there will be found a little hole in its body, covered with a fine transparent membrane. This is thought, by Linnæus, to be the instrument it employs in singing; but others are of opinion the sound is produced by rubbing its hinder legs against each other: however this be, the note of one male is seldom heard but it is returned by another; and the two little animals, after many mutual insults of this kind, are seen to meet and fight desperately. The female is generally the reward of victory: for, after the combat, the male seizes her with his teeth behind the neck, and thus keeps her for several hours, till the business of fecundation is performed. They are at the time so strongly united, that they can scarcely be separated without tearing asunder. Towards the latter end of autumn the female prepares to deposit her burden, and her body is then seen greatly distended with her eggs, which she carries to the number of a hundred and fifty. In order to make a

proper lodgment in the earth for them, nature has furnished her with an instrument at her tail, somewhat resembling a two-edged sword, which she can sheath and unsheath at pleasure: with this she pierces the earth as deep as she is able, and into the hole which her instrument has made she deposits her eggs, one after the other.

Having thus provided for the continuation of her posterity, the animal herself does not long survive; but, as the winter approaches, she dries up, seems to feel the effects of age, and dies from a total decay. Some however assert, that she is killed by the cold, and others, that she is eaten by worms; but certain it is, that neither the male nor female are ever seen to survive the winter. In the mean time, the eggs which have been depostied continue unaltered, either by the severity of the season, or the retardation of the spring. They are of an oval figure, white, and of the consistence of horn; their size nearly equals that of a grain of anise; they are enveloped in the body within a covering, branched all over with veins and arteries; and when excluded, they crack on being pressed between the fingers: their substance within is a whitish, viscous, and transparent fluid. In this manner they remain deposited beneath the surface of the earth during the whole winter, till the genial return of spring begins to vivify and hatch them. The sun with its warmth beginning to animate all nature, the insect eggs feel its benign influence, and generally, about the beginning of May, every egg produces an insect, about the size of a flea. These at first are of a whitish colour; at the end of two or three days they turn black, and soon after they become of a reddish-brown. They appear, from the beginning, like grasshoppers wanting wings, and hop among the grass, as soon as excluded, with great agility.

Yet still they are by no means arrived at their state of full perfection, although they bear a strong resemblance to the animal in its perfect form. They want, or seem to want, the wings, which they are at last seen to assume, and can only hop among the grass without being able to fly. The wings, however, are not wanting, but are concealed within four little bunches, that seem to deform the sides of the animal; there they lie rolled up in a most curious manner, and occupying a smaller space than one could conceive who saw them extended. Indeed, all insects, whatever transmutations they seem to undergo, are yet brought forth with those very limbs, parts, and wings, which they afterwards seem to acquire. In the most helpless caterpillar, there is still to be seen the rudiments of that beautiful plumage which it afterwards expands when a butterfly; and though many new parts seem unfolded to the view, the animal acquires none but such as it was from the beginning possessed of. The grasshopper, therefore, though seemingly without wings, is in reality from the first possessed of those instruments, and only waits for sufficient force to break the bonds that hold them folded up, and to give them their full expansion.

The grasshopper, that for above twenty days from its exclusion has continued without the use of its wings, which are folded up to

its body, at length prepares for its emancipation, and for a life of greater liberty and pleasure. To make the proper dispositions for the approaching change, it ceases from its grassy food, and seeks about for a convenient place, beneath some thorn or thistle, that may protect it from an accidental shower. The same laborious writhings and workings, heavings and palpitations, which we have remarked in every other insect upon an approaching change, are exhibited in this. It swells up its head and neck; it then seems to draw them in again; and thus alternately, for some time, it exerts its powers to get free. At length the skin covering the head and breast is seen divided above the neck; the head is seen issuing out first from the bursting skin; the efforts still continuing, the other parts follow successively; so that the little animal, with its long feelers, legs and all, works its way from the old skin, that remains fixed to the thistle or the thorn. It is indeed inconceivable how the insect can thus extricate itself from so exact a sheath as that which covered every part of its body.

The grasshopper, thus disengaged from its outer skin, appears in its perfect form; but then so feeble, and its body so soft and tender, that it may be moulded like wax. It is no longer of that obscure colour which it exhibited before, but a greenish-white, which becomes more vivid as the moisture on the surface is dried away. Still, however, the animal continues to show no signs of life, but appears quite spent and fatigued with its labour for more than an hour together. During this time, the body is dying, and the wings unfolded to the greatest expansion; and the curious observer will perceive them, fold after fold, opening to the sun, till at last they become longer than the two hinder legs. The insect's body also is lengthened during this operation, and it becomes much more beautiful than before.

These insects are generally vocal in the midst of summer; and they are heard at sun-setting much louder than during the heats of the day. They are fed upon grass; and, if their belly be pressed, they will be seen to return the juices of the plants they have last fed upon. Though unwilling to fly, and slow in flight, particularly when the weather is moist or cool, they are sometimes seen to fly to considerable distances. If they are caught by one of the hinder legs, they quicky disengage themselves from it, and leave the leg behind them. This, however, does not grow again, as with crabs or spiders; for, as they are animals but of a single year's continuance, they have not sufficient time for repairing those accidental misfortunes. The loss of their leg also prevents them from flying; for, being unable to lift themselves in the air, they have not room upon the ground for the proper expansion of their wings. If they be handled roughly, they will bite very fiercely; and when they fly they make a noise with their wings. They generally keep in the plain, where the grass is luxuriant, and the ground rich and fertile; there they deposit their eggs, particularly in those cracks which are formed by the heat of the sun.

LOCUSTS.

MOTH, WITH ITS CATERPILLAR AND AURELIA.

Such are the habits and nature of those little vocal insects, that swarm in our meadows, and enliven the landscape. The larger kinds only differ from them in size, in rapidity of flight, and the powers of injuring mankind, by swarming upon the productions of the earth. The quantity of grass which a few grasshoppers that sport in the field can destroy, is trifling: but when a swarm of locusts, two or three miles long, and several yards deep, settle upon a field, the consequences are frightful. The annals of every country are marked with the devastation which such a multitude of insects produces; and though they seldom visit Europe in such dangerous swarms as formerly, yet in some of the southern kingdoms they are still formidable. Those which have at uncertain intervals visited Europe, in our memory, are supposed to have come from Africa, and the animal is called the Great Brown Locust. It was seen in several parts of England in the year 1748, and many dreadful consequences were apprehended from its appearance. This insect is about three inches long, and has two horns or feelers an inch in length. The head and horns are of a brownish colour; it is blue about the mouth, as also on the inside of the larger legs. The shield that covers the back is greenish, and the upper side of the body brown, spotted with black, and the under side purple. The upper wings are brown, with small dusky spots, with one larger at the tips; the under wings are more transparent, and of a light brown tinctured with green, but there is a dark cloud of spots near the tips. This is that insect that has threatened us so often with its visitations, and that is so truly terrible in those countries where it is bred. There is no animal in the creation that multiplies so fast as these, if the sun be warm, and the soil in which their eggs are deposited be dry. Happily for us, the coldness of our climate, and the humidity of our soil, are no way favourable to their production; and as they are but the animals of a year, they visit us and perish.

The Scripture, which was written in a country where the locust made a distinguished feature in the picture of nature, has given us several very striking images of this animal's numbers and rapacity. It compares an army, where the numbers are almost infinite, to a swarm of locusts: it describes them as rising out of the earth, where they are produced; as pursuing a settled march to destroy the fruits of the earth, and co-operating with Divine indignation.

When the locusts take the field, as we are assured, they have a leader at their head, whose flight they observe, and pay a strict attention to all his motions. They appear at a distance like a black cloud, which as it approaches gathers upon the horizon, and almost hides the light of the day. It often happens that the husbandman sees this imminent calamity pass away without doing him any mischief, and the whole swarm proceed onward to settle upon the labours of some less fortunate country. But wretched is the district upon which they settle: they ravage the meadow and the pasture ground, strip the trees of their leaves, and the garden

of its beauty; the visitation of a few minutes destroys the expectation of a year, and a famine but too frequently ensues. In their native tropical climates they are not so dreadful as in the more southern parts of Europe. There, though the plain and the forest be stripped of their verdure, the power of vegetation is so great, that an interval of three or four days repairs the calamity; but our verdure is the livery of a season, and we must wait till the ensuing spring repairs the damage. Besides, in their long flights to this part of the world, they are famished by the tediousness of their journey, and are therefore more voracious wherever they happen to settle. But it is not by what they devour that they do so much damage, as by what they destroy. Their very bite is thought to contaminate the plant, and to prevent its vegetation. To use the expression of the husbandman, they burn whatever they touch, and leave the marks of their devastation for two or three years ensuing. But if they be noxious while living, they are still more so when dead; for wherever they fall, they infect the air in such a manner, that the smell is insupportable. Orosius tells us, that in the year of the world 3800, there was an incredible number of locusts which infected Africa; and after having eaten up every thing that was green, they flew off, and were drowned in the African Sea, where they caused such a stench, that the putrefying bodies of hundreds of thousands of men could not equal it.

In the year 1690 a cloud of locusts was seen to enter Russia in three different places, and from thence to spread themselves over Poland and Lithuania, in such astonishing multitudes, that the air was darkened, and the earth covered with their numbers. In some places they were seen lying dead heaped upon each other four feet deep; in others, they covered the surface like a black cloth: the trees bent beneath their weight; and the damage which the country sustained exceeded computation. In Barbary their numbers are formidable, and their visits are frequent. In the year 1724, Dr. Shaw was a witness in that country of their devastations. Their first appearance was about the latter end of March, when the wind had been southerly for some time: in the beginning of April, their numbers were so vastly increased, that in the heat of the day they formed themselves into large swarms, which appeared like clouds, and darkened the sun. In the middle of May they began to disappear, retiring into the plains to deposit their eggs. In the next month, being June, the young brood began to make their appearance, forming many compact bodies of several hundred yards square; and afterwards marching forward, climbed the trees, walls, and houses, eating every thing that was green in their way. The inhabitants, to stop their progress, laid trenches all over their fields and gardens, filling them with water. Some placed large quantities of heath, stubble, and such like combustible matter, in rows, and set them on fire on the approach of the locusts. But all this was to no purpose; for the trenches

were quickly filled up, and the fires put out by the vast number of swarms that succeeded each other. A day or two after one of these was in motion, others, that were just hatched, came to glean after them, gnawing off the young branches and the very bark of the trees. Having lived near a month in this manner, they arrived at their full growth, and threw off their worm-like state, by casting their skins. To prepare themselves for this change, they fixed their hinder feet to some bush or twig, or corner of a stone, when immediately, by an undulating motion used on this occasion, their heads would first appear, and soon after the rest of their bodies. The whole transformation was performed in seven or eight minutes time; after which they were a little while in a languishing condition; but as soon as the sun and air had hardened their wings, and dried up the moisture that remained after casting off their sloughs, they returned again to their former greediness, with an addition both of strength and agility. But they did not continue long in this state before they were entirely dispersed, after laying their eggs directing their course northward, and probably perished in the sea. It is said that the holes these animals make to deposit their eggs in, are four feet deep in the ground; the eggs are about fourscore in number, of the size of carraway comfits, and bundled up together in clusters.

It would be endless to recount all the mischiefs which these famished insects have at different times occasioned; but what can have induced them to take such distant flights, when they come into Europe, is not easy to be accounted for. It seems most probable, that by means of a very dry season in the heart of Africa, they are propagated in such numbers, that the vegetables of the spot where they are produced are not sufficient to sustain them. Thus being obliged to find out other countries, they traverse the sandy deserts, where they can find no sustenance: still meeting with nothing to allure them from their height, they proceed forward across the sea, and thus come into Europe, where they alight upon the first green pastures that occur.

In some parts of the world the inhabitants turn what seems a plague to their own advantage. Locusts are eaten by the natives in many kingdoms of the East; and are caught in small nets provided for that purpose. They parch them over the fire in an earthen pan; and when their wings and legs are fallen off, they turn reddish, of the colour of boiled shrimps. Dampier has eat them thus prepared, and thinks them a tolerable dish. The natives of Barbary also eat them fried with salt; and they are said to taste like cray-fish.

There is a locust in Tonquin, about the bigness of the top of a man's finger, and as long as the first joint. It breeds in the earth, in low grounds; and in the months of January and February, which is the season for taking them, they issue from the earth in vast swarms. At first they can hardly fly, so that they often fall into the rivers in great numbers: however, the natives in these

months watch the rivers, and take them up in multitudes in small nets. They either eat them fresh, broiled on the coals, or pickle them for keeping. They are considered as a great delicacy in that part of the world, as well by the rich as the poor. In the countries where they are eaten, they are regularly brought to market, and sold, as larks or quails in Europe. They must have been a common food with the Jews, as Moses, in the book of Leviticus, permits them to eat four different kinds of this animal, which he takes care to specify. This dish, however, has not yet made its way into the kitchens of the luxurious in Europe; and though we may admire the delicacies of the East, we are as yet happily deprived of the powers of imitation.

Of all animals, however, of this noxious tribe, the Great West Indian Locust, individually considered, is the most formidable. It is about the thickness of the barrel of a goose-quill, and the body is divided into nine or ten joints, in the whole about six or seven inches long. It has two small eyes, standing out of the head like those of crabs, and two feelers like long hairs. The whole body is studded with small excrescences, which are not much bigger than the points of pins. The shape is roundish, and the body diminishes in circumference to the tail, which is forked into two horns. Between these there is a sort of a sheath, containing a small dangerous sting. If any person happens to touch this insect, he is sure to be stung; and is immediately taken with a shivering and a trembling all over the body; which, however, may soon be put a stop to, by rubbing the place that was affected with a little palm-oil.

From the Locust we descend to the Cricket, which is a very inoffensive and pretty animal. Though there be a species of this insect that lives entirely in the woods and fields, yet that with which we are best acquainted is the house cricket, whose voice is so well known behind a country fire in a winter's evening. There is something so unusual in hearing a sound while we do not see the animal producing it, nor discover the place from whence it comes, that among the country people the chirping of the cricket is always held ominous; and whether it deserts the fire-side, or pays an unexpected visit, the credulous peasantry always find something to be afraid of. In general, however, the killing of a cricket is a most unlucky omen; and though their company is not so much desired, yet no methods must be taken to remove them.

The cricket very much resembles the grasshopper in its shape, its manner of ruminating, its voice, its leaping, and methods of propagation. It differs in its colour, which is uniformly of a rusty brown; in its food, which is more various; and in its place of residence, which is most usually in the warmest chinks behind a country hearth. They are, in some, obliged to the bad masonry employed in making peasants' houses for their retreats. The smallest chink serves to give them shelter; and where they once make their abode, they are sure to propagate. They are of a most

chilly nature, seldom leaving the fire-side; and, if undisturbed, are seen to hop from their retreats to chirrup at the blaze in the chimney. The wood cricket is the most timorous animal in nature; but the chimney cricket, being used to noises, disregards not only those, but the appearance of people near it. Whether the voice of this animal is formed in the same manner with that of the grasshopper, by a fine membrane at the base of the wings, which is moved by a muscle, and which being coiled up, gives a sound like a quail-pipe, is not yet ascertained; nor do we well know the use of this voice, since anatomical inspection has not yet been able to discover the smallest organs of hearing. Still, however, we can make no doubt of their power of distinguishing sounds, though probably not in the same manner with the more perfect ranks of nature. Certain it is, that I have often heard them call, and this call was as regularly answered by another, although none but the males are vocal.

As the cricket lives chiefly in the dark, so its eyes seem formed for the gloominess of its abode; and those who would surprise it, have only to light a candle unexpectedly, by which it is dazzled, and cannot find the way back to its retreat. It is a very voracious little animal, and will eat bread, flour, and meat; but it is particularly fond of sugar. They never drink, but keep for months together at the back of the chimney, where they could possibly have had no moisture. The warmth of their situation only serves to increase their mirth and loquacity. Except in the very coldest weather they never cease their chirruping, but continue that little piercing note, which is as pleasing to some as it is disagreeable to others. The great Scaliger was particularly delighted with the chirruping of crickets, and kept several of them for his amusement, enclosed in a box, which he placed in a warm situation. Others, on the contrary, think there is something ominous and melancholy in the sound, and use every endeavour to banish this insect from their houses. Ledelius tells us of a woman who was very much incommoded by crickets, and tried, but in vain, every method of banishing them from her house. She at last accidentally succeeded; for having one day invited several guests to her house, where there was a wedding, in order to increase the festivity of the entertainment, she procured drums and trumpets to entertain them. The noise of those was so much greater than what the little animals were used to, that they instantly forsook their situation, and were never heard in that mansion more.

But of all the cricket kind, that which is called the Mole Cricket is the most extraordinary. This animal is the largest of all the insects with which we are acquainted in this country, being two inches and a half in length, and three quarters of an inch in breadth. The colour is of a dusky brown; and at the extremity of the tail there are two hairy excrescences, resembling in some sense the tail of a mouse. The body consists of eight scaly joints or separate folds, is brown on the upper part, and more deeply

tinged below. The wings are long, narrow, and terminate in a sharp point, each having a blackish line running down it: however, when they are extended, they appear to be much broader than could at first sight be supposed. The shield of the breast is of a firm texture, of a blackish colour, and hairy. The fore-feet, which are this animal's principal instruments of burrowing into the earth, are strong, webbed, and hairy; it generally, however, runs backward; but it is commonly under ground, where it burrows even faster than a mole. It is thought also to be amphibious, and capable of living under water as well as under ground.

Of all insects this is the most detested by gardeners, as it chiefly resides in that ground which lies light, and where it finds sufficient plenty under the surface. Thus, in a single night's time, it will run along a furrow which has been newly sown, and rob it of all its contents. Its legs are formed in such a manner that it can penetrate the earth in every direction,—before, behind, and above it. At night it ventures from its underground habitation, and, like the cricket, has its chirping call. When the female is fecundated, she makes a cell of clammy earth, the inside of which is large enough to hold two hazel nuts, and in this she lays her eggs. The whole nest is about the size of a common hen's egg, closed up on every side, and well defended from the smallest breath of air. The eggs generally amount to the number of a hundred and fifty, being white, and about the size of a carraway comfit. They are thus carefully covered, as well to defend them from the injuries of the weather, as from the attacks of the black beetle; that being itself an underground inhabitant, would, but for this precaution, devour or destroy them. To prevent this, the female mole cricket is often posted as a sentinel near the nest, and when the black invader plunges in to seize its prey, the guardian insect seizes him behind, and instantly bites him in two.

Nothing can exceed the care and assiduity which these animals exhibit in the preservation of their young. Wherever the nest is placed, there seems to be a fortification, avenues, and intrenchments, drawn round it; there are numberless winding ways that lead to it, and a ditch drawn about it, which few of its insect enemies are able to pass. But their care is not confined to this only; for at the approach of winter they carry their nest entirely way, and sink it deeper in the ground, so that the frost can have no influence in retarding the young brood from coming to maturity. As the weather grows milder, they raise their magazine in proportion, till at last they bring it as near the surface as they can to receive the genial influence of the sun, without wholly exposing it to view: yet should the frost unexpectedly return, they sink it again as before.

[The Great Lantern Fly is found in China and Peru. The fore part of the head of this animal is drawn, extended, and empty; the antennæ are seated below the eyes, having two articulations, whereof the exterior is larger, and of a globular form; the beak is

inflected, or bent inwards under the body; and the feet are made for walking. The head and thorax are generally of a ruddy brown; and the ground colour of the elytra is fresh green, but quaintly figured with spots of a yellowish clay colour, sometimes paler at other seasons of a deeper hue. The wings are of a deep and beautiful yellow, with a broad band of glossy black bordering the extremities. The tarsi of the feet are composed of three articulations, and are of a paler colour than the legs and thighs, which are brown. When the insect is on the wing, the waving of the elytra, (whose thinness renders the spots thereon transparent,) assisted by the luminous quality peculiar to the tribe, and the golden yellow of the under wings, bordered with black, occasion the flashes they dart around in the night; and the phosphorescent light contained in the head is sufficient to answer the purposes of a candle in a dark room.]

CHAPTER V.

OF THE EARWIG, THE FROTH INSECT, AND OTHERS BELONGING TO THE SECOND ORDER OF INSECTS.

We should still keep in memory that all insects of the second order, though not produced quite perfect from the egg, yet want very little of their perfection, and require but a very small change to arrive at that state which fits them for flight and generation. The natural functions in these are never suspended: from the instant they leave the egg, they continue to eat, to move, to leap, and pursue their prey; a slight change ensues, a skin that enclosed a part of their body and limbs bursts behind, like a woman's stays, and gives freedom to a set of wings, with which the animal expatiates, and flies in pursuit of its mate.

Of all this class of insects, the Earwig undergoes the smallest change. This animal is so common that it scarcely needs a description: its swiftness in the reptile state is not less remarkable than its indefatigable velocity when upon the wing. That it must be very prolific, appears from its numbers; and that it is very harmless, every one's experience can readily testify. It is provided with six feet and two feelers; the tail is forked, and with this it often attempts to defend itself against every assailant. But its attempts are only the threats of impotence; they draw down the resentment of powerful animals, but no way serve to defend it. The deformity of its figure, and its slender make, have also subjected it to an imputation, which, though entirely founded in prejudice, has more than once procured its destruction. It is supposed, as the name imports, that it often enters into the ears of people sleeping, thus causing madness from the intolerable pain,

and soon after death itself. Indeed, the French name, which signifis *the ear-piercer*, urges the calumny against this harmless insect in very plain terms; yet nothing can be more unjust; the ear is already filled with a substance which prevents any insect from entering; and besides, it is well lined and defended with membranes, which would keep out any little animal, even though the ear-wax were away. These reproaches, therefore, are entirely groundless; but it were well if the accusations which gardeners bring against the earwig were as slightly founded. There is nothing more certain than that it lives among flowers, and destroys them. When fruit also has been wounded by flies, the earwig generally comes in for a second feast, and sucks those juices which they first began to broach. Still, however, this insect is not so noxious as it would seem, and seldom is found but where the mischief has been originally begun by others. Like all of this class, the earwig is hatched from an egg. As there are various kinds of this animal, so they choose different places to breed in: in general, however, they lay their eggs under the bark of plants, or in the clefts of trees when beginning to decay. They proceed from the egg in that reptile state in which they are most commonly seen, and as they grow larger, the wings bound under the skin begin to bourgeon. It is amazing how very little room four large wings take up before they are protruded, for no person could ever conceive such an expansion of natural drapery could be rolled up in so small a packet. The sheath in which they are enveloped folds and covers them so neatly, that the animal seems quite destitute of wings;* and even when they are burst from their confinement, the animal, by the power of the muscles and joints which it has in the middle of its wings, can closely fold them into a very narrow compass. When the earwig has become a winged insect, it flies in pursuit of the female, ceasing to feed, and is wholly employed in the business of propagation. It lives in its winged state but a few days; and having taken care for the continuance of posterity, dries up and dies, to all appearance consumptive.

To this order of insects we may also refer the Cuckoo Spit or Froth Worm, that is often found hid in that frothy matter which we find on the surface of plants. It has an oblong obtuse body, and a large head, with small eyes. The external wings, for it has four, are of a dusky brown, marked with two white spots; the head is black. The spume in which it is found wallowing is all of its own formation, and very much resembles frothy spittle. It proceeds from the vent of the animal, and other parts of the body; and if it be wiped away, a new quantity will be quickly seen ejected from the little animal's body. Within this spume it is seen in time to acquire four tubercles on its back, wherein the wings are enclosed; these bursting, from a reptile it becomes a

* Swammerdam, p. 114.

winged animal, and thus rendered perfect, it flies to meet its mate, and propagate its kind.

The Water Tipula also belongs to this class. It has an oblong slender body, with four feet fixed upon the breast, and four feelers near the mouth. It has four weak wings, which do not at all seem proper for flying, but leaping only. But what this insect chiefly demands our attention for is, the wonderful lightness wherewith it runs on the surface of the water, so as scarcely to put it in motion. It is sometimes seen in rivers, and on their banks, especially under shady trees, and generally in swarms of several together.

The Common Water Fly also breeds in the same manner with those above mentioned. This animal is by some called *Notonecta*, because it does not swim in the usual manner, upon its belly, but on its back; nor can we help admiring that fitness in this insect for its situation, as it feeds on the under side of plants which grow on the surface of the water; and therefore it is thus formed with its mouth upwards, to take its food with greater convenience and ease.

We may also add the Water Scorpion, which is a large insect, being near an inch in length, and about half an inch in breadth. Its body is nearly oval, but very flat and thin, and its tail long and pointed. The head is small, and the feelers appear like legs, resembling the claws of a scorpion, but without sharp points. This insect is generally found in ponds, and is of all others the most tyrannical and rapacious. It destroys, like a wolf among sheep, twenty times as many as its hunger requires. One of these, when put into a basin of water in which were thirty or forty worms of the libellula kind, each as large as itself, destroyed them all in a few minutes, getting on their backs, and piercing with its trunk through their body. These animals, however, though so formidable to others, are nevertheless themselves greatly overrun with a little kind of louse, about the size of a nit, which very probably repays the injury which the water scorpion inflicts upon others.

The water scorpions live in the water by day, out of which they rise in the dusk of the evening into the air, and so flying from place to place, often betake themselves in quest of food to other waters. The insect, before its wings are grown, remains in the place where it was produced; but when come to its state of perfection, sallies forth in search of a companion of the other sex, in order to continue its noxious posterity.

CHAPTER VI.

OF THE EPHEMERA.

THE last insect we shall add to the second order, is the Ephemera; which, though not strictly belonging to it, yet seems more

properly referred to this rank than any other. Indeed, we must not attend to the rigour of method in a history where nature seems to take delight to sport in variety.

That there should be a tribe of flies whose duration extends but to a day, seems at first surprising; but the wonder will increase when we are told, that some of this kind seem to be born and to die in the space of a single hour. The reptile, however, from which they are bred, is by no means so short-lived; but is sometimes seen to live two years, and many times three years together.

All ephemeras, of which there are various kinds, are produced from the egg, in the form of worms, from whence they change into a more perfect form, namely, that of aurelias, which is a kind of middle state between a worm and a fly; and from thence they take their last mutation, which is into a beautiful fly, of longer or shorter duration, according to its kind.

The ephemera, in its fly state, is a very beautiful winged insect, and has a strong similitude to the butterfly, both from its shape and its wings. It is about the size of a middling butterfly; but its wings differ, in not being covered with the painted dust with which those of the butterflies are adorned, and rendered opaque, for they are very transparent and very thin. These insects have four wings, the uppermost of which are much the largest: when the insect is at rest, it generally lays its wings one over the other on the back. The body is long, being formed of six rings, that are larger at the origin than near the extremity; and from this a tail proceeds, that is longer than all the rest of the fly, and consists sometimes of three threads of an equal length, or sometimes of two long and one short. To acquire this beautiful form, the insect has been obliged to undergo several transmutations; but its glory is very short-lived, for the hour of its perfection is the hour of its death, and it seems scarcely introduced to pleasure, when it is obliged to part with life.

The reptile that is to become a fly, and that is granted so long a term, when compared to its latter duration, is an inhabitant of the water, and bears a very strong resemblance to fishes in many particulars; having gills by which it breathes at the bottom, and also the tapering form of aquatic animals. These insects have six scaly legs fixed on their corslet. Their head is triangular; the eyes are placed forward, and may be distinguished by their largeness and colour. The mouth is furnished with teeth; and the body consists of six rings, that next the corslet being largest, but growing less and less to the end; the last ring is the shortest, from which the three threads proceed, which are as long as the whole body. Thus we see that the reptile bears a very strong resemblance to the fly, and only requires wings to be very near its perfection.

As there are several kinds of this animal, their aurelias are consequently of different colours; some yellow, some brown, and some cream-coloured. Some of these also bore themselves cells at the bottom of the water, from which they never stir out, but feed upon

the mud composing the walls of their habitation, in contented captivity; others, on the contrary, range about, go from the bottom to the surface, swim between two waters, quit that element entirely to feed upon plants by the river side, and then return to their favourite element for safety and protection.

The reptile, however, though it lives two or three years, offers but little, in its long duration, to excite curiosity; it is hid at the bottom of the water, and feeds almost wholly within its narrow habitation. The most striking facts command our attention during the short interval of its fly state, into which it crowds the most various transactions of its little life. It then may be said to be in a hurry to live, as it has but so small a time to exist. The peculiar sign whereby to know that these reptiles will change into flies in a short time, consists in a protuberance of the wings on the back. About that time the smooth and depressed form of the upper part of the body is changed into a more swoln and rounder shape, so that the wings are in some degree visible through the external sheath that covers them. As they are not natives of England, he who would see them in their greatest abundance must walk, about sun-set, along the banks of the Rhine, or the Seine, near Paris; where, for about three days in the midst of summer, he will be astonished at their numbers and assiduity. The thickest descent of the flakes of snow in winter seems not to equal their number; the whole air seems alive with the new-born race, and the earth itself is all over covered with their remains. The aurelias, or reptile insects, that are as yet beneath the surface of the water, wait only for the approach of evening to begin their transformation. The most industrious shake off their old garments about eight o'clock; and those who are the most tardy, are transformed before nine.

We have already seen that the operation of change in other insects is laborious and painful; but with these nothing seems shorter, or performed with greater ease. The aurelias are scarcely lifted above the surface of the water before their old sheathing skin bursts; and through the cavity which is thus formed, a fly issues, whose wings at the same instant are unfolded, and at the same time lift it into the air. Millions and millions of aurelias rise in this manner to the surface, and at once becomes flies, and fill every quarter with their flutterings. But all these sports are shortly to have an end, for as the little stranger lives but an hour or two, the whole swarm soon falls to the ground, and covers the earth, like a deep snow, for several hundred yards on every side of the river. Their numbers are then incredible, and every object they touch becomes fatal to them; for they instantly die, if they even hit against each other.

At this time the males and females are very differently employed. The males, quite inactive and apparently without desires, seem only born to die: no way like the males of other insects, they neither follow the opposite sex, nor bear any enmity to each other; after fluttering for an hour or two, they drop upon land, without

seeming to receive wings for scarcely any other purpose but to satisfy an idle curiosity. It is otherwise with the females, that are scarcely risen from the surface of the water, and have dried their wings, but they hasten to drop their eggs back again. If they happen also to flutter upon the land, they deposit their burden in the place where they drop. But then it may be demanded, where and in what manner are these eggs fecundated, as no copulation whatever appears between the sexes in the transitory visits in air? Swammerdam is of opinion, that they are impregnated in the manner of fish spawn, by the male, after being ejected by the female; but, beside that this doctrine is exploded even from the history of fishes, it is certain that the males have not time for this operation, as the eggs drop to the bottom the instant they are laid on the water. Reaumur is of opinion that they copulate, but that the act bears a proportion in shortness to the small duration of their lives, and consequently must be so soon performed as to be scarcely visible. This, however, is at best forcing a theory; and it is probable, that as there are many insects known to breed without any impregnation from the male, as we have already seen in muscles and oysters, and shall hereafter see in the gnat, and a species of the beetle, so the ephemera may be of this number. Be this as it may, the females are in such haste to deposit their eggs, that multitudes of them fall to the ground, but the greatest part are laid in the water. As they flutter upon the surface, two clusters are seen issuing from the extremity of their bodies, each containing about three hundred and fifty eggs, which make seven hundred in all. Thus, of all insects, this appears to be the most prolific; and it would seem that there was a necessity for such a supply, as in its reptile state it is the favourite food of every kind of fresh water fish. It is in vain that these little animals form galleries at the bottom of the river, from whence they seldom remove; many kinds of fish break in upon their retreats, and thin their numbers. For this reason, fishermen are careful to provide themselves with these insects, as the most grateful bait, and thus turn the fish's rapacity to its own destruction.

But though the usual date of those flies is two or three hours at farthest, there are some kinds that live several days; and one kind in particular, after quitting the water, has another case or skin to get rid of. These are often seen in the fields and woods, distant from the water; but they are more frequently found in its vicinity. They are often found sticking upon walls and trees; and frequently with the head downwards, without changing place, or having any sensible motion. They are then waiting for the moment when they shall be divested of their last incommodious garment, which sometimes does not happen for two or three days together.

PART III.

OF INSECTS OF THE THIRD ORDER.

CHAPTER I.

OF CATERPILLARS IN GENERAL.

If we take a cursory view of insects in general, Caterpillars alone, and the butterflies and moths they give birth to, will make a third part of the number. Wherever we move, wherever we turn, these insects, in one shape or another, present themselves to our view. Some, in every state, offer the most entertaining spectacle; others are beautiful only in their winged form. Many persons, of which number I am one, have an invincible aversion to caterpillars, and worms of every species; there is something disagreeable in their slow crawling motion, for which the variety of their colouring can never compensate. But others feel no repugnance at observing, and even handling them with the most attentive application.

There is nothing in the butterfly state so beautiful or splendid as these insects. They serve, not less than the birds themselves, to banish solitude from our walks, and to fill up our idle intervals with the most pleasing speculations. The butterfly makes one of the principal ornaments of oriental poetry; but in those countries the insect is larger and more beautiful than with us.

The beauties of the fly may therefore very well excite our curiosity to examine the reptile. But we are still more strongly attached to this tribe, from the usefulness of one of the number. The silk-worm is, perhaps, the most serviceable of all other animals; since, from its labours, and the manufacture attending it, near a third part of the world are clothed, adorned, and supported.

Caterpillars may be easily distinguished from worms or maggots, by the number of their feet, and by their producing butterflies or moths. When the sun calls up vegetation, and vivifies the various eggs of insects, the caterpillars are the first that are seen, upon almost every vegetable and tree, eating its leaves, and preparing for a state of greater perfection. They have feet both before and behind, which not only enable them to move forward by a sort of steps made by their fore and hinder parts, but also to climb up vegetables, and to stretch themselves out from the boughs and stalks, and to reach their food at a distance. All of this class have from eight feet, at the least, to sixteen; and this may serve to distinguish them from the worm tribe, that never have so many. The animal into which they are converted is always a butterfly or a

moth; and these are always distinguished from other flies, by having their wings covered over with a painted dust, which gives them such various beauty. The wings of flies are transparent, as we see in the common flesh fly, while those of the beetles are hard, like horn; from such the wings of a butterfly may be easily distinguished, and words would obscure their differences.

From hence it appears, that caterpillars, whether in the reptile state, or advanced to their last state of perfection into butterflies, may easily be distinguished from all other insects, being animals peculiarly formed, and also of a peculiar nature. The transmutations they undergo are also more numerous than those of any insect hitherto mentioned; and, in consequence, they have been placed in the third order of changes by Swammerdam, who has thrown such lights upon this part of natural history. In the second order of changes, mentioned before, we saw the grasshopper and the earwig, when excluded from the egg, assume a form very like that which they were after to preserve; and seemed arrived at a state of perfection in all respects, except in not having wings, which did not bud forth until they were come to maturity. But the insects of this third order, that we are now about to describe, go through a much greater variety of transformations; for, when they are excluded from the egg, they assume the form of a small caterpillar, which feeds and grows larger every day, often changing its skin, but still preserving its form. When the animal has come to a certain magnitude in this state, it discontinues eating, makes itself a covering or husk, in which it remains wrapped up, seemingly without life or motion; and after having for some time continued in this state, it once more bursts its confinement, and comes forth a butterfly. Thus we see this animal put on no less than three different appearances from the time it is first excluded from the egg. It appears a crawling caterpillar; then an insensible aurelia, as it is called, without life or motion; and lastly, a beautiful butterfly, variously painted, according to its different kind. Having thus distinguished this class of insects from all others, we will first survey their history in general, and then enter particularly into the manners and nature of a few of them which most deserve our curiosity and attention.

CHAPTER II.

OF THE TRANSFORMATION OF THE CATERPILLAR INTO ITS CORRESPONDING BUTTERFLY OR MOTH.

When winter has disrobed the trees of their leaves, nature then seems to have lost her insects. There are thousands of different kinds, with and without wings, which, though swarming at other seasons, then entirely disappear. Our fields are repeopled, when

the leaves begin to bud, by the genial influence of spring; and caterpillars, of various sorts, are seen feeding upon the promise of the year, even before the leaves are completely unfolded. Those caterpillars which we then see, may serve to give us a view of the general means which nature employs to preserve such a number of insects during that season when they can no longer find subsistence. It is known, by united experience, that all these animals are hatched from eggs of butterflies; and those who observe them more closely, will find the fly very careful in depositing its eggs in those places where they are likely to be hatched with the greatest safety and success. During winter, therefore, the greatest number of caterpillars are in an egg state; and in this lifeless situation brave all the rigours and the humidity of the climate; and though often exposed to all its changes, still preserve the latent principles of life, which is more fully exerted at the approach of spring. The same power that pushes forth the budding leaf and the opening flower, impels the insect into animation; and nature at once seems to furnish the guest and the banquet. When the insect has found force to break its shell, it always finds its favourite aliment provided in abundance before it.

But all caterpillars are not sent off from the egg in the beginning of spring; for many of them have subsisted during the winter in their aurelia state, in which, as we have briefly observed above, the animal is seemingly deprived of life and motion. In this state of insensibility many of these insects continue during the rigours of winter: some enclosed in a kind of shell, which they have spun for themselves at the end of autumn; some concealed under the bark of trees, others in the chinks of old walls, and many buried under ground. From all these a variety of butterflies are seen to issue in the beginning of spring, and adorn the earliest part of the year with their painted flutterings.

Some caterpillars do not make any change whatsoever at the approach of winter, but continue to live in their reptile state through all the severity of the season. These choose themselves some retreat, where they may remain undisturbed for months together; and there they continue motionless, and as insensible as if they were actually dead. Their constitution is such, that food at that time would be useless, and the cold prevents their making those dissipations which require restoration. In general, caterpillars of this kind are found in great numbers together, enclosed in one common web, that covers them all, and serves to protect them from the injuries of the air.

Lastly, there are some of the caterpillar kind whose butterflies live all the winter, and who, having fluttered about for some part of the latter end of autumn, seek for some retreat during the winter, in order to answer the ends of propagation at the approach of spring. These are often found lifeless or motionless in the hollows of trees or the clefts of timber; but, by being approached to the fire, they recover life and activity, and seem to anticipate the desires of spring.

In general, however, whether the animal has subsisted in an egg state during the winter; or whether as a butterfly, bred from an aurelia, in the beginning of spring; or a butterfly that has subsisted during the winter, and lays eggs as soon as the leaves of plants are shot forward; the whole swarm of caterpillars are in motion to share the banquet that nature has provided. There is scarcely a plant that has not its own peculiar insects, and some are known to support several of different kinds. Of these, many are hatched from the egg at the foot of the tree, and climb up to its leaves for subsistence; the eggs of others have been glued by the parent butterfly to the leaves, and they are no sooner excluded from the shell but they find themselves in the midst of plenty.

When the caterpillar first bursts from the egg, it is small and feeble; its appetites are in proportion to its size, and it seems to make no great consumption: but as it increases in magnitude it improves in its appetites; so that, in its adult caterpillar state, it is the most ravenous of all animals whatsoever. A single caterpillar will eat double its own weight of leaves in a day, and yet seems no way disordered by the meal.—What would mankind do if their oxen or their horses were so voracious?

These voracious habits, with their slow crawling motion, but still more a stinging like that of nettles, which follows upon handling the greatest number of them, make these insects not the most agreeable objects of human curiosity. However, there are many philosophers who have spent years in their contemplation, and who have not only to attended their habits and labours, but minutel examined their structure and internal conformation.

The body of the caterpillar, when anatomically considered, is found composed of rings, whose circumference is pretty near circular or oval. They are generally twelve in number, and are all membranaceous, by which caterpillars may be distinguished from many other insects that nearly resemble them in form. The head of the caterpillar is connected to the first ring by the neck, that is generally so short and contracted that it is scarcely visible. All the covering of the head in caterpillars seems to consist of a shell; and they have neither upper nor under jaw, for they are both placed rather vertically, and each jaw armed with a large thick tooth, which is singly equal to numbers. With these the animals devour their food in such amazing quantities; and with these some of the kind defend themselves against their enemies. Though the mouth be kept shut, the teeth are always uncovered; and while the insect is in health, they are seldom without employment. Whatever the caterpillar devours, these teeth serve to chop it into small pieces, and render the parts of the leaf fit for swallowing. Many kinds, while they are yet young, eat only the succulent parts of the leaf, and leave all the fibres untouched; others, however, attack the whole leaf, and eat it clean away. One may be amused, for a little time, in observing the avidity with which they are seen to feed; some are seen eating the whole day, others have their

hours of repast; some choose the night and others the day. When the caterpillar attacks a leaf, it places its body in such a manner that the edge of the leaf shall fall between its feet, which keeps it steady while the teeth are employed in cutting it; these fall upon the leaf somewhat in the manner of a pair of gardener's shears, and every morsel is swallowed as soon as cut. Some caterpillars feed upon leaves so very narrow, that they are not broader than their mouths; in this case the animal is seen to devour it from the point, as we would eat a radish.

As there are various kinds of caterpillars, the number of their feet are various, some having eight, and some sixteen. Of these feet the six foremost are covered with a sort of shining gristle, and are therefore called the shelly legs. The hindmost feet, whatever be their number, are soft and flexible, and are called membranaceous. Caterpillars also, with regard to their external figure, are either smooth or hairy. The skin of the first kind is soft to the touch, or hard like shagreen; the skin of the latter is hairy, and as it were thorny, and generally, if handled, stings like nettles. Some of them even cause this stinging pain, if but approached too nearly.

Caterpillars in general have six small black spots placed on the circumference of the fore ring, and a little to the side of the head. Three of these are larger than the rest, and are convex and transparent: these Reaumur takes to be the eyes of the caterpillar; however, most of these reptiles have very little occasion for sight, and seem only to be directed by their feeling.

But the parts of the caterpillar's body which most justly demand our attention, are the *stigmata*, as they are called; or those holes on the sides of its body through which the animal is supposed to breathe. All along this insect's body on each side, these holes are easily discoverable. They are eighteen in number, nine on a side, rather nearer the belly than the back; a hole for every ring of which the animal's body is composed, except the second, the third, and the last. These oval openings may be considered as so many mouths, through which the insect breathes; but with this difference, that as we have but one pair of lungs, the caterpillar has no less than eighteen. It requires no great anatomical dexterity to discover these lungs in the larger kind of caterpillars; they appear at first view to be hollow cartilaginous tubes, and of the colour of mother-of-pearl. These tubes are often seen to unite with each other; some are perceived to open into the intestines, and some go to different parts of the surface of the body. That these vessels serve to convey the air, appears evidently from the famous experiment of Malpighi; who, by stopping up the mouth of the stigmata with oil, quickly suffocated the animal, which was seen to die convulsed the instant after. In order to ascertain his theory, he rubbed oil upon other parts of the insect's body, leaving the stigmata free; and this seemed to have no effect upon the animal's health, but it continued to move and eat as usual: he rubbed oil on the stigmata

of one side, and the animal underwent a partial convulsion, but recovered soon after. However, it ought to be observed, that air is not so necessary to these as to the nobler ranks of animals, since caterpillars will live in an exhausted receiver for several days together; and though they seem dead at the bottom, yet, when taken out, recover, and resume their former vivacity.

If the caterpillar be cut open longitudinally along the back, its intestines will be perceived running directly in a straight line from the mouth to the anus. They resemble a number of small bags opening into each other, and strengthened on each side by a fleshy cord, by which they are united. These insects are, upon many occasions, seen to cast forth the internal coat of their intestines with their food, in the changes which they so frequently undergo. But the intestines take up but a small part of the animal's body, if compared to the fatty substance in which they are involved. This substance changes its colour when the insect's metamorphosis begins to approach; and from white it is usually seen to become yellow. If to these parts we add the caterpillar's implements for spinning (for all caterpillars spin at one time or another), we shall have a rude sketch of this animal's conformation: however, we shall reserve the description of those parts, till we come to the history of the silk-worm, where the manner in which these insects spin their webs will most properly find place.

The life of a caterpillar seems one continued succession of changes; and it is seen to throw off one skin to assume another; which also is divested in its turn: and thus for eight or ten times successively. We must not, however, confound this changing of the skin with the great metamorphosis which it is afterwards to undergo. The throwing off one skin and assuming another, seems, in comparison, but a slight operation among these animals; this is but the work of a day, the other is the great adventure of their lives. Indeed, this faculty of changing the skin is not peculiar to caterpillars only, but is common to all the insect kind, and even to some animals that claim a higher rank in nature. We have already seen the lobster and the crab outgrowing their first shells, and then bursting from their confinement, in order to assume a covering more roomy and convenient. It is probable that the louse, the flea, and the spider, change their covering from the same necessity; and growing too large for the crust in which they have been for some time enclosed, burst it for another. This period is probably that of their growth; for as soon as their new skin is hardened round them, the animal's growth is necessarily circumscribed while it remains within it. With respect to caterpillars, many of them change their skins five or six times in a season; and this covering, when cast off, often seems so complete, that many might mistake the empty skin for the real insect. Among the hairy caterpillars, for instance, the cast skin is covered with hair; the feet, as well gristly as membraneous, remain fixed to it; even the parts which nothing but a microscope can discover are

visible in it: in short, all the parts of the head, not only the skull, but the teeth.

In proportion as the time approaches, in which the caterpillar is to cast its old skin, its colour becomes more feeble, the skin seems to wither and grow dry, and in some measure resembles a leaf when it is no longer supplied with moisture from the stock. At that time the insect begins to find itself under the necessity of changing; and it is not effected without violent labour, and perhaps pain. A day or two before the critical hour approaches, the insect ceases to eat, loses its usual activity, and seems to rest immoveable. It seeks some place to remain in security; and no longer timorous, seems regardless even of the touch. It is now and then seen to bend itself and elevate its back; again it stretches to its utmost extent: it sometimes lifts up its head, and then lets it fall again; it sometimes waves it three or four times from side to side, and then remains in quiet. At length some of the rings of its body, particularly the first and second, are seen to swell considerably, the old skin distends and bursts, till by repeated swellings and contractions in every ring, the animal disengages itself, and creeps from its inconvenient covering.

How laborious soever this operation may be, it is performed in the space of a minute; and the animal having thrown off its old skin, seems to enjoy new vigour, as well as acquired colouring and beauty. Sometimes it happens that it takes a new appearance, and colours very different from the old. Those that are hairy still preserve their covering, although their ancient skin seems not to have lost a single hair; every hair appear to have been drawn, like a sword from the scabbard. However, the fact is, that a new crop of hair grows between the old skin and the new, and probably helps to throw off the external covering.

The caterpillar having in this manner continued for several days feeding, and at intervals casting its skin, begins at last to prepare for its change into an aurelia. It is most probable, that from the beginning all the parts of the butterfly lay hid in this insect in its reptile state; but it required time to bring them to perfection, and a large quantity of food to enable the animal to undergo all the changes requisite for throwing off these skins, which seem to clog the butterfly form. However, when the caterpillar has fed sufficiently, and parts of the future butterfly have formed themselves beneath its skin, it is then time for it to make its first great and principal change into an aurelia, or a chrysalis, as some have chosen to call it; during which, as was observed, it seems to remain for several days, or even months, without life or motion.

Preparatory to this important change, the caterpillar most usually quits the plant or the tree on which it fed, or at least attaches itself to the stalk or the stem, more gladly than the leaves. It forsakes its food, and prepares by fasting to undergo its transmutation. In this period, all the food it has taken is thoroughly

digested, and it often voids even the internal membrane which lined its intestines. Some of this tribe, at this period also, are seen entirely to change colour; and the vivacity of the tints in all seems faded. Those of them which are capable of spinning themselves a web, set about this operation; those which have already spun, await the change in the best manner they are able. The web or cone with which some cover themselves, hides the aurelia contained within from the view; but in others, where it is more transparent, the caterpillar, when it has done spinning, strikes into it the claws of the two feet under the tail, and afterwards forces in the tail itself, by contracting those claws, and violently striking the feet one against the other. If, however, they be taken from their web at this time, they appear in a state of great languor, and, incapable of walking, remain on that spot where they are placed. In this condition they remain one or two days, preparing to change into an aurelia, somewhat in the manner they made preparation for changing their skin. They then appear with their bodies bent into a bow, which they now and then are seen to straighten; they make no use of their legs, but if they attempt to change place, do it by the contortions of their body. In proportion as their change into an aurelia approaches, their bodies become more and more bent, while their extensions and convulsive contractions become more frequent. The hinder end of the body is the part which the animal first disengages from its caterpillar skin; that part of the skin remains empty, while the body is drawn up contractedly towards the head. In the same manner they disengage themselves from the two succeeding rings, so that the animal is lodged entirely in the fore part of its caterpillar covering; that half which is abandoned remains lax and empty, while the fore part, on the contrary, is swoln and distended. The animal having thus quitted the hinder part of its skin to drive itself up into the fore part, still continues to heave and work as before; so that the skull is soon seen to burst into three pieces, and a longitudinal opening is made in the three first rings of the body, through which the insect thrusts forth its naked body, with strong efforts. Thus at last it entirely gets free from its caterpillar skin, and for ever forsakes its most odious reptile form.

The caterpillar, thus stripped of its skin for the last time, is now become an aurelia; in which the parts of the future butterfly are all visible, but in so soft a state, that the smallest touch can discompose them. The animal is now become helpless and motionless; but only waits for the assistance of the air to dry up the moisture on its surface, and supply it with a crust capable of resisting external injuries. Immediately after being stripped of its caterpillar skin, it is of a green colour, especially in those parts which are distended by an extraordinary afflux of animal moisture; but in ten or twelve hours after being thus exposed, its parts harden, the air forms its external covering into a firm crust, and in about four-and-twenty hours, the aurelia may be handled, without endangering the little animal that is thus left in so defenceless a situation. Such

is the history of the little pod or cone that is found so common by every path-way, sticking to nettles, and sometimes shining like polished gold. From the beautiful and resplendent colour with which it is thus sometimes adorned, some authors have called it a Chrysalis, implying a creature made of gold.

Such are the efforts by which these little animals prepare for a state of perfection; but their care is still greater to provide themselves a secure retreat during the season of their imbecility. It would seem like erecting themselves a monument, where they were to rest secure, until nature had called them into a new and more improved existence. For this purpose, some spin themselves a cone or web, in which they lie secure till they have arrived at maturity; others, that cannot spin so copious a covering, suspend themselves by the tail, in some retreat where they are not likely to meet disturbances. Some mix sand with their gummy and moist webs, and thus make themselves a secure incrustation; while others, before their change, bury themselves in the ground, and thus avoid the numerous dangers that might attend them. One would imagine that they were conscious of the precise time of their continuance in their aurelia state, since their little sepulchres, with respect to the solidity of the building, are proportioned to such duration. Those that are to lie in that state of existence but a few days, make choice of some tender leaf, which they render still more pliant by diffusing a kind of glue upon it; the leaf thus gradually curls up, and withering as it enfolds, the insect wraps itself within, as in a mantle, till the genial warmth of the sun enables it to struggle for new life, and burst from its confinement. Others, whose time of transformation is also near at hand, fasten their tails to a tree, or to the first worm-hole they meet in a beam, and wait in that defenceless situation. Such caterpillars, on the other hand, as are seen to lie several months in their aurelia state, act with much greater circumspection. Most of them mix their web with sand, and thus make themselves a strong covering; others build in wood, which serves them in the nature of a coffin. Such as have made the leaves of willows their favourite food, break the tender twigs of them first into small pieces, then pound them as it were to powder; and by means of their glutinous silk, make a kind of paste, in which they wrap themselves up. Many are the forms which these animals assume in this helpless state; and it often happens, that the most deformed butterflies issue from the most beautiful aurelias.

In general, however, the aurelia takes the rude outline of the parts of the animal which is contained within it; but as to the various colours which it is seen to assume, they are rather the effect of accident; for the same species of insect does not at all times assume the same hue when it becomes an aurelia. In some, the beautiful gold colour is one at time found; in others it is wanting. This brilliant hue, which does not fall short of the best gilding, is formed in the same manner in which we see leather obtain a gold

colour, though none of that metal ever enters into the tincture. It is only formed by a beautiful brown varnish, laid upon a white ground; and the white thus gleaming through the transparency of the brown, gives a charming golden yellow. These two colours are found, one over the other, in the aurelia of the little animal we are describing; and the whole appear gilded, without any real gilding.

The aurelia thus formed, and left to time to expand into a butterfly, in some measure resembles an animal in an egg, that is to wait for external warmth to hatch it into life and vigour. As the quantity of moisture that is enclosed within the covering of the aurelia, continues to keep its body in the most tender state, so it is requisite that this humidity should be dried away, before the little butterfly can burst its prison. Many have been the experiments to prove that nature may in this respect be assisted by art; and that the life of the insect may be retarded or quickened, without doing it the smallest injury. For this purpose, it is only requisite to continue the insect in its aurelia state, by preventing the evaporation of its humidity; which will consequently add some days, nay weeks, to its life: on the other hand, by evaporating its moisture in a warm situation, the animal assumes its winged state before its usual time, and goes through the offices assigned its existence. To prove this, M. Reaumur enclosed the aurelia in a glass tube, and found the evaporated water which exhaled from the body of the insect, collected in drops at the bottom of the tube; he covered the aurelia with varnish, and this making the evaporation more difficult and slow, the butterfly was two months longer than its natural term in coming out of its case: he found, on the other hand, that by laying the animal in a warm room, he hastened the disclosure of the butterfly; and by keeping it in an ice-house in the same manner, he delayed it. Warmth acted, in this case, in a double capacity, invigorating the animal, and evaporating the moisture.

The aurelia, though it bears a different external appearance, nevertheless contains within it all the parts of the butterfly in perfect formation, and lying each in a very orderly manner, though in the smallest compass. These, however, are so fast and tender, that it is impossible to visit without discomposing them. When either by warmth, or increasing vigour, the parts have acquired the necessary force and solidity, the butterfly then seeks to disembarrass itself of those bands which kept it so long in confinement. Some insects continue under the form of an aurelia not above ten days, some twenty, some several months, and even for a year together.

The butterfly, however, does not continue so long under the form of an aurelia as one would be apt to imagine. In general, those caterpillars that provide themselves with cones, continue within them but a few days after the cone is completely finished. Some, however, remain buried in this artificial covering for eight or

nine months, without taking the smallest sustenance during the whole time; and though in the caterpillar state no animals were so voracious, when thus transformed they appear a miracle of abstinence. In all, sooner or later, the butterfly bursts from its prison, not only that natural prison which is formed by the skin of the aurelia, but also from that artificial one of silk, or any other substance in which it has enclosed itself.

The efforts which the butterfly makes to get free from its aurelia state, are by no means so violent as those which the insect had in changing from the caterpillar into the aurelia. The quantity of moisture surrounding the butterfly is by no means so great as that attending its former change; and the shell of the aurelia is so dry, that it may be cracked between the fingers.

If the animal be shut up within the cone, the butterfly always gets rid of the natural internal skin of the aurelia, before it eats its way through the external covering which its own industry has formed round it. In order to observe the manner in which it thus gets rid of the aurelia covering, we must cut open the cone, and then we shall have an opportunity of discovering the insect's efforts to emancipate itself from its natural shell. When this operation begins, there seems to be a violent agitation in the humours contained within the little animal's body. Its fluid seems driven, by a hasty fermentation, through all the vessels, while it labours violently with its legs, and makes several other violent struggles to get free. As all these motions concur with the growth of the insect's wings and body, it is impossible that the brittle skin which covers it should longer resist; it at length gives way, by bursting into four distinct and regular pieces. The skin of the head and legs first separates; then the skin at the back flies open, and dividing into two regular portions, disengages the back and wings; then there likewise happens another rupture in that portion which covered the rings of the back of the aurelia. After this, the butterfly, as if fatigued with its struggles, remains very quiet for some time, with its wings pointed downwards, and its legs fixed in the skin which it had just thrown off. At first sight, the animal, just set free, and permitted the future use of its wings, seems to want tham entirely; they take up such little room, that one would wonder where they were hidden. But soon after, they expand so rapidly, that the eye can scarcely attend their unfolding. From reaching scarcely half the length of the body, they acquire, in a most wonderful manner, their full extent and bigness, so as to be each five times larger than they were before. Nor is it the wings alone that are thus increased; all their spots and paintings, before so minute as to be scarcely discernible, are proportionably extended; so that, what a few minutes before seemed only a number of confused, unmeaning points, now become distinct and most beautiful ornaments. Nor are the wings, when they are thus expanded, unfolded in the manner in which earwigs and grasshoppers display theire, who unfurl them like a lady's fan; on the contrary, those

of butterflies actually grow to their natural size in this very short space. The wing, at the instant it is freed from its late confinement, is considerably thicker than afterwards; so that it spreads in all its dimensions, growing thinner as it becomes broader. If one of the wings be plucked from the animal just set free, it may be spread by the fingers, and it will soon become as broad as the other which has been left behind. As the wings extend themselves so suddenly, they have not yet had time to dry, and accordingly appear like pieces of wet paper, soft and full of wrinkles. In about half an hour they are perfectly dry, their wrinkles entirely disappear, and the little animal assumes all its splendour. The transmutation being thus perfectly finished, the butterfly discharges three or four drops of a blood-coloured liquid, which are the last remains of its superfluous moisture. Those aurelias which are enclosed within a cone find their exit more difficult, as they have still another prison to break through: this, however, they perform in a short time; for the butterfly, freed from its aurelia skin, butts with its head violently against the walls of its artificial prison; and probably with its eyes, that are rough and like a file, it rubs the internal surface away, till it is at last seen bursting its way into open light, and, in less than a quarter of an hour, the animal acquires its full perfection.

Thus, to use the words of Swammerdam, we see a little insignificant creature distinguished, in its last birth, with qualifications and ornaments, which man, during his stay upon earth, can never even hope to acquire. The butterfly, to enjoy life, needs no other food but the dews of heaven, and the honied juices which are distilled from every flower. The pageantry of princes cannot equal the ornaments with which it is invested, nor the rich colouring that embellishes its wings. The skies are the butterfly's proper habitation, and the air its element; whilst man comes into the world naked, and often roves about without habitation or shelter; exposed, on one hand, to the heat of the sun, and on the other, to the damps and exhalations of the earth, both alike enemies of his happiness and existence. A strong proof that, while this little animal is raised to its greatest height, we are as yet, in this world, only candidates for perfection!

CHAPTER III.

OF BUTTERFLIES AND MOTHS.

It has been already shown, that all Butterflies are bred from caterpillars: and we have exhibited the various circumstances of that surprising change. It has been remarked, that butterflies may be easily distinguished from flies of every other kind by their wings; for, in others, they are either transparent, like gauze, as we see in

STAG BEETLE.

BUTTERFLY.

the common flesh fly; or they are hard and crusted, as we see in the wings of the beetle. But in the butterfly, the wings are soft, opaque, and painted over with a beautiful dust that comes off with handling.

The number of these beautiful animals is very great; and though Linnæus has reckoned up above seven hundred and sixty different kinds, the catalogue is still very incomplete. Every collector of butterflies can show undescribed species; and such as are fond of minute discovery, can here produce animals that have been examined only by himself. In general, however, those of the warm climates are larger and more beautiful than such as are bred at home; and we can easily admit the beauty of the butterfly, since we are thus freed from the damage of the caterpillar. It has been the amusement of some to collect these animals from different parts of the world, or to breed them from caterpillars at home. These they arrange in systematic order, or dispose so as to make striking and agreeable pictures; and all must grant, that this specious idleness is far preferable to that unhappy state which is produced by a total want of employment.

The wings of butterflies, as was observed, fully distinguish them from flies of every other kind. They are four in number; and although two of them be cut off, the animal can fly with the two others remaining. They are, in their own substance, transparent; but owe their opacity to the beautiful dust with which they are covered, and which has been likened, by some naturalists, to the feathers of birds, by others, to the scales of fishes, as their imaginations were disposed to catch the resemblance. In fact, if we regard the wing of a butterfly with a good microscope, we shall perceive it studded over with a variety of little grains of different dimensions and forms, generally supported upon a foot-stalk, regularly laid upon the whole surface. Nothing can exceed the beautiful and regular arrangement of these little substances, which thus serve to paint the butterfly's wing, like the tiles of a house. Those of one rank are a little covered by those that follow; they are of many figures: on one part of the wing may be seen a succession of oval studs, on another part a cluster of studs, each in the form of a heart; in one place they resemble a hand open, and in another they are long or triangular; while all are interspersed with taller studs, that grow between the rest, like mushrooms upon a stalk. The wing itself is composed of several thick nerves, which render the construction very strong, though light; and though it be covered over with thousands of these scales or studs, yet its weight is very little increased by the number. The animal is with ease enabled to support itself a long while in the air, although its flight be not very graceful. When it designs to fly to a considerable distance, it ascends and descends alternately; going sometimes to the right, sometimes to the left, without any apparent reason. Upon closer examination, however, it will be found that it flies thus irregularly in pursuit of its mate; and as dogs bait and quarter the ground in pursuit

their game, so these insects traverse the air in quest of their mates, whom they can discover at more than a mile's distance.

If we prosecute our description of the butterfly, the animal may be divided into three parts; the head, the corslet, and the body.

The body is the hinder part of the butterfly, and is composed of rings, which are generally concealed under long hair, with which that part of the animal is clothed. The corslet is more solid than the rest of the body, because the fore wings and the legs are fixed therein. The legs are six in number, although four only are made use of by the animal; the two fore legs being often so much concealed in the long hair of the body, that its sometimes difficult to discover them. If we examine these parts internally, we shall find the same set of vessels in the butterfly that we observed in the caterpillar, but with this great difference,—that as the blood, or humour in the caterpillar, circulated from the tail to the head, they are found, in the butterfly, to take a direct contrary course, and to circulate from the head to the tail: so that the caterpillar may be considered as the embryo animal, in which, as we have formerly seen, the circulation is carried on differently from what it is in animals when excluded.

But leaving the other parts of the butterfly, let us turn our attention particularly to the head. The eyes of butterflies have not all the same form; for in some they are large, in others small; in some they are the larger proportion of a sphere, in others they are but a small part of it, and just appearing from the head. In all of them, however, the outward coat has a lustre, in which may be discovered the various colours of the rainbow. When examined a little closely, it will be found to have the appearance of the multiplying glass; having a great number of sides, or facets, in the manner of a brilliant cut diamond. In this particular, the eye of the butterfly, and of most other insects, entirely correspond; and Leuwenhoek pretends, there are above six thousand facets on the cornea of a flea. These animals, therefore, see not only with great clearness, but view every object multiplied in a surprising manner. Puget adapted the cornea of a flea in such a position, as to see objects through it by the means of a microscope: and nothing could exceed the strangeness of its representations: a soldier, who was seen through it, appeared like an army of pigmies; for while it multiplied it also diminished the object; the arch of a bridge exhibited a spectacle more magnificent than human, skill could perform; the flame of a candle seemed a beautiful illumination. It still, however, remains a doubt, whether the insect sees objects singly, as with one eye, or whether every facet is itself a complete eye, exhibiting its own object distinct from all the rest.

Butterflies, as well as most other flying insects, have two instruments like horns on their heads, which are commonly called feelers. They differ from the horns of greater animals, in being

moveable at their base, and in having a great number of joints, by which means the insect is enabled to turn them in every direction. Those of butterflies are placed at the top of the head, pretty near the external edge of each eye. What the use of these instruments may be, which are thus formed with so much art, and by a Workman who does nothing without reason, is as yet unknown to man. They may serve to guard the eye, they may be of use to clean it, or they may be the organ of some sense which we are ignorant of; but this is only explaining one difficulty by another.

We are not so ignorant of the uses of the trunk, which few insects of the butterfly kind are without. This instrument is placed exactly between the eyes; and when the animal is not employed in seeking its nourishment, it is rolled up like a curl. A butterfly, when it is feeding, flies round some flower, and settles upon it. The trunk is then uncurled, and thrust out either wholly or in part, and is employed in searching the flower to its very bottom, let it be ever so deep. This search being repeated seven or eight times, the butterfly then passes to another; and continues to hover over those agreeable to its taste, like a bird over its prey. This trunk consists of two equal hollow tubes, nicely joined to each other, like the pipes of an organ.

Such is the figure and conformation of these beautiful insects, that cheer our walks, and give us the earliest intimations of summer. But it is not by day alone that they are seen fluttering wantonly from flower to flower, as the greatest number of them fly by night, and expand the most beautiful colouring at those hours when there is no spectator. This tribe of insects has therefore been divided into Diurnal and Nocturnal Flies, or more properly speaking, into Butterflies and Moths; the one flying only by day, the other most usually on the wing in the night. They may be easily distinguished from each other by their horns or feelers; those of the butterfly being clubbed, or knobbed at the end, those of the moth tapering finer and finer to a point. To express it technically—the feelers of butterflies are clavated, those of moths are filiform.

The butterflies, as well as the moths, employ the short life assigned them in a variety of enjoyments. Their whole time is spent either in quest of food, which every flower offers, or in pursuit of the female, whose approach they can often perceive at two miles distance. Their sagacity in this particular is not less astonishing than true; but by what sense they are thus capable of distinguishing each other at such distances, is not easy to conceive. It cannot be by the sight, since such small objects as they are must be utterly imperceptible at half the distance at which they perceive each other; it can scarcely be by the sense of smelling, since the animal has no organs for that purpose. Whatever be their powers of perception, certain it is, that the male, after having fluttered, as if carelessly, about for some time, is seen to take wing, and go forward, sometimes for two miles together, in a direct line to where the female is perched on a flower.

The general rule among insects is, that the female is larger than

the male; and this obtains particularly in the tribe I am describing. The body of the male is smaller and slenderer, that of the female more thick and oval. Previous to the junction of these animals, they are seen sporting in the air, pursuing and flying from each other, and preparing, by a mock combat, for the more important business of their lives. If they be disturbed while united, the female flies off with the male on her back, who seems entirely passive upon the occasion.

But the female of many moths and butterflies seem to have assumed their airy form for no other reason but to fecundate their eggs, and lay them. They are not seen fluttering about in quest of food, or a mate; all that passes during their short lives, is a junction with the male of about half an hour, after which they deposit their eggs, and die, without taking any nourishment, or seeking any. It may be observed, however, that in all the females of this tribe, they are impregnated by the male by one aperture, and lay their eggs by another.

The eggs of female butterflies are disposed in the body like a bed of chaplets, which, when excluded, are usually oval, and of a whitish colour; some, however, are quite round, and others flatted like a turnip. The covering or shell of the egg, though solid, is thin and transparent; and in proportion as the caterpillar grows within the egg, the colours change, and are distributed differently. The butterfly seems very well instructed by nature in the choice of the plant or the leaf where it shall deposit its burden. Each egg contains but one caterpillar, and it is requisite that this little animal, when excluded, should be near its peculiar provision. The butterfly, therefore, is careful to place her brood only upon those plants that afford good nourishment to its posterity. Though the little winged animal has been fed itself upon dew, or the honey of flowers, yet it makes choice for its young of a very different provision, and lays its eggs on the most unsavory plants—the ragweed, the cabbage, or the nettle. Thus every butterfly chooses, not the plant most grateful to it in its winged state, but such as it has fed upon in its reptile form.

All the eggs of butterflies are attached to the leaves of the favourite plant, by a sort of size or glue, where they continue unobserved, unless carefully sought after. The eggs are sometimes placed round the tender shoots of plants, in the form of bracelets, consisting of above two hundred in each, and generally surrounding the shoot, like a ring upon a finger. Some butterflies secure their eggs from the injuries of air, by covering them with hair plucked from their own bodies, as birds sometimes are seen to make their nests; so that their eggs are thus kept warm, and also entirely concealed.

All the tribe of female moths lay their eggs a short time after they leave the aurelia; but there are many butterflies that flutter about the whole summer, and do not think of laying till the winter begins to warn them of their approaching end; some even continue

the whole winter in the hollows of trees, and do not provide for posterity until the beginning of April, when they leave their retreats, deposit their eggs, and die. Their eggs soon begin to feel the genial influence of the season; the little animals burst from them in their caterpillar state, to become aurelias and butterflies in their turn, and thus to continue the round of nature.

CHAPTER IV.

OF THE ENEMIES OF THE CATERPILLAR.

NATURE, though it has rendered some animals surprisingly fruitful, yet ever takes care to prevent their too great increase. One set of creatures is generally opposed to another; and those are chiefly the most prolific that are, from their imbecility, incapable of making any effectual defence. The caterpillar has, perhaps, of all other animals, the greatest number of enemies, and seems only to exist by its surprising fecundity. Some animals devour them by hundreds; others, more minute, yet more dangerous, mangle them in various ways; so that, how great soever their numbers may be, their destroyers are in equal proportion. Indeed, if we consider the mischiefs these reptiles are capable of occasioning, and the various damages we sustain from their insatiable rapacity, it is happy for the other ranks of nature that there are thousands of fishes, birds, and even insects, that live chiefly upon caterpillars, and make them their most favourite repast.

When we describe the little birds that live in our gardens, and near our houses, as destructive neighbours, sufficient attention was not paid to the services which they are frequently found to render us. It has been proved, that a single sparrow and its mate, that have young ones, destroy above three thousand caterpillars in a week; not to mention several butterflies, in which numberless caterpillars are destroyed in embryo. It is in pursuit of these reptiles that we are favoured with the visits of many of our most beautiful songsters, that amuse us during their continuance, and leave us when the caterpillars disappear.

The maxim which has often been urged against man, that he, of all other animals, is the only creature that is an enemy to his own kind, and that the human species only are found to destroy each other, has been adopted by persons who never considered the history of insects. Some of the caterpillar kind in particular, that seem fitted only to live upon leaves and plants, will, however, eat each other; and the strongest will devour the weak, in preference to their vegetable food. That which lives upon the oak is found to seize any of its companions which it conveniently can, by the first rings, and inflict a deadly wound; it then feasts in tranquillity on its prey, and leaves nothing of the animal but the husk.

But it is not from each other they have the most to fear, as in

general they are inoffensive, and many of this tribe are found to live in a kind of society. Many kind of flies lay their eggs either upon or within their bodies, and as these turn into worms, the caterpillar is seen to nourish a set of intestine enemies within its body, that must shortly be its destruction; nature having taught flies, as well as all other animals, the surest methods of perpetuating their kind. "Towards the end of August," says Reaumur, "I perceived a little fly, of a beautiful gold colour, busily employed in the body of a large caterpillar, of that kind which feeds upon cabbage. I gently separated that part of the leaf on which these insects were placed from the rest of the plant, and placed it where I might observe them more at my ease. The fly, wholly taken up by the business in which it was employed, walked along the caterpillar's body, now and then remaining fixed to a particular spot. Upon this occasion I perceived it every now and then dart a sting, which it carried at the end of its tail, into the caterpillar's body, and then drew it out again to repeat the same operation in another place. It was not difficult for me to conjecture the business which engaged this animal so earnestly; its whole aim was to deposit its eggs in the caterpillar's body, which was to serve as a proper retreat for bringing them to perfection. The reptile thus rudely treated, seemed to bear all very patiently, only moving a little when stung too deeply; which, however, the fly seemed entirely to disregard. I took particular care to feed this caterpillar, which seemed to me to continue as voracious and vigorous as any of the rest of its kind. In about ten or twelve days it changed into an aurelia, which seemed gradually to decline, and died. Upon examining its internal parts, the animal was entirely devoured by worms, which; however, did not come to perfection, as it is probable they had not enough to sustain them within."

What the French philosopher perceived upon this occasion, is every day to be seen in several of the larger kinds of caterpillars, whose bodies serve as a nest to various flies, that very carefully deposit their eggs within them. The large cabbage caterpillar is so subject to its injuries, that at certain seasons it is much easier to find them with than without them. The ichneumon fly, as it is called, particularly infests these reptiles, and prevents their fecundity. This fly is of all others the most formidable to insects of various kinds. The spider, that destroys the ant, the moth, and the butterfly, yet often falls a prey to the ichneumon, who pursues the robber to his retreat, and despising his nets tears him in pieces, in the very labyrinth he has made. This insect, as redoubtable as the little quadruped that destroys the crocodile, has received the same name; and from its destruction of the caterpillar tribe, is probably more serviceable to mankind:—This insect, I say, makes the body of the caterpillar the place for depositing its eggs, to the number of ten, fifteen, or twenty. As they are laid in those parts which are not mortal, the reptile still continues to live and to feed, showing no signs of being incommoded by its new guests. The

caterpillar changes its skin, and sometimes undergoes the great change into an aurelia; but still the fatal intruders work within, and secretly devour its internal substances: soon after, they are seen bursting through its skin, and moving away, in order to spin themselves a covering previous to their own little transformation. It is indeed astonishing sometimes to see the number of worms, and those pretty large, that thus issue from the body of a single caterpillar, and eat their way through its skin; but it is more extraordinary still, that they should remain within the body, devouring its entrails, without destroying its life. The truth is, they seem instructed by nature not to devour its vital parts; for they are found to feed only upon that fatty substance which composes the largest part of the caterpillar's body. When this surprising appearance was first observed, it was supposed that the animal thus gave birth to a number of flies, different from itself, and that the same caterpillar sometimes bred an ichneumon, and sometimes a butterfly; it was not till after more careful inspection it was discovered, that the ichneumon tribe were not the caterpillar's offspring, but its murderers.

CHAPTER V.

OF THE SILK-WORM.

Having mentioned in the last chapter, the damages inflicted by the caterpillar tribe, we now come to an animal of this kind that alone compensates for all the mischief occasioned by the rest. This little creature, which only works for itself, has been made of the utmost service to man, and furnishes him with a covering more beautiful than any other animal can supply. We may declaim, indeed, against the luxuries of the times, when silk is so generally worn; but were such garments to fail, what other arts could supply their deficiency?

Though silk was anciently brought in small quantities to Rome, yet it was so scarce as to be sold for its weight in gold, and was considered as such a luxurious refinement in dress, that it was infamous for a man to appear in habits of which silk formed but half the composition. It was most probably brought among them from the most remote parts of the East, since it was, at that time of which I am speaking, scarcely known even in Persia.

Nothing can be more remote from the truth than the manner in which their historians describe the animal by which silk is produced. Pausanias informs us, that silk came from the country of the Seres, a people of Asiatic Scythia; in which place an insect, as large as the beetle, but in every other respect resembling a spider, was bred up for that purpose. They take great care, as he assures us, to feed and defend it from the weather, as well during

the summer's heat as the rigours of winter. This insect, he observes, makes its web with its feet, of which it has eight in number. It is fed for the space of four years upon a kind of paste prepared for it, and at the beginning of the fifth it is supplied with the leaves of the green willow, of which it is particularly fond. It then feeds till it bursts with fat; after which they take out its bowels, which are spun into the beautiful manufacture so scarce and costly.

The real history of this animal was unknown among the Romans till the time of Justinian, and it is supposed that silk-worms were not brought into Europe till the beginning of the twelfth century, when Roger of Sicily brought workmen in this manufacture from Asia Minor, after his return from his expedition to the Holy Land, and settled them in Sicily and Calabria. From these the other kingdoms of Europe learned this manufacture, and it is now one of the most lucrative carried on among the southern provinces of Europe.

The silk-worm is now very well known to be a large caterpillar, of a whitish colour, with twelve feet, and producing a butterfly of the moth kind. The cone on which it spins is formed for covering it while it continues in the aurelia state; and several of these properly wound off, and united together, form those strong and beautiful threads which are woven into silk. The feeding these worms, the gathering, the winding, the twisting, and the weaving their silk, is one of the principal manufactures of Europe, and, as our luxuries increase, seems every day to become more and more necessary to human happiness.

There are two methods of breeding silk-worms; for they may be left to grow, and to remain at liberty upon the trees where they are hatched; or they may be kept in a place built for that purpose, and fed every day with fresh leaves. The first method is used in China, Tonquin, and other hot countries; the other is used in those places where the animal has been artificially propagated, and still continues a stranger. In the warm climates, the silk-worm proceeds from an egg, which has been glued by the parent moth upon proper parts of the mulberry tree, and which remains in that situation during the winter. The manner in which they are situated and fixed to the tree keeps them unaffected by the influence of the weather, so that those frosts which are severe enough to kill the tree, have no power to injure the silk-worm.

The insect never proceeds from the egg till nature has provided it a sufficient supply, and till the budding leaves are furnished in a sufficient abundance for its support. When the leaves are put forth, the worms seem to feel the genial summons, and bursting from their little eggs, crawl upon the leaves, where they feed with a most voracious appetite. Thus they become larger by degrees; and after some months' feeding, they lay upon every leaf small bundles or cones of silk, which appear like so many golden apples painted on a fine green ground. Such is the method of breeding them in

the East; and without doubt it is best for the worms, and least troublesome for the feeder of them. But it is otherwise in our colder European climates: the frequent changes of the weather, and the heavy dews of our evenings, render the keeping them all night exposed subject to so many inconveniences as to admit of no remedy. It is true, that by the assistance of nets they may be preserved from the insults of birds; but the severe cold weather which often succeeds the first heats of summer, as well as the rain and high winds, will destroy them all; and therefore, to breed them in Europe, they must be sheltered and protected from every external injury.

For this purpose a room is chosen with a south aspect, and the windows are so well glazed as not to admit the least air; the walls are well built, and the planks of the floor are exceeding close, so as to admit neither birds, nor mice, nor even so much as an insect. In the middle there should be four pillars erected, or four wood posts, so placed as to form a pretty large square. Between these are different stories made with osier hurdles; and under each hurdle there should be a floor, with an upright border all around. These hurdles and floors must hang upon pullies, so as to be placed, or taken down at pleasure.

When the worms are hatched, some tender mulberry leaves are provided, and placed in the cloth or paper box in which the eggs were laid, and which are large enough to hold a great number. When they have acquired some strength, they must be distributed on beds of mulberry leaves, in the different stories of the square in the middle of the room, round which a person may freely pass on every side. They will fix themselves to the leaves, and afterwards to the sticks of the hurdles, when the leaves are devoured. They have then a thread, by which they can suspend themselves on occasion, to prevent any shock by a fall; but this is by no means to be considered as the silk which they spin afterwards in such abundance. Care must be taken that fresh leaves be brought every morning, which must be strewed very gently and equally over them; upon which the silk-worms will forsake the remainder of the old leaves, which must be carefully taken away, and every thing kept very clean; for nothing hurts these insects so much as moisture and uncleanliness. For this reason their leaves must be gathered when the weather is dry, and kept in a dry place, if it be necessary to lay in a store. As these animals have but a short time to live, they make use of every moment, and almost continually are eating, except at those intervals when they change their skins. If mulberry leaves be difficult to be obtained, the leaves of lettuce or hollyhock will sustain them; but they do not thrive so well upon their new diet, and their silk will neither be so copious, nor of so good a quality.

Though the judicious choice, and careful management of their diet is absolutely necessary, yet there is another precaution of equal importance, which is to give them air, and open their chamber

windows, at such times as the sun shines warmest. The place also must be kept as clean as possible, not only the several floors that are laid to receive their ordure, but the whole apartments in general. These things well observed, contribute greatly to their health and increase.

The worm, at the time it bursts the shell, is extremely small and of a black colour, but the head is of a more shining black than the rest of the body; some days after, they begin to turn whitish, or of an ash-coloured-grey. After the skin begins to grow too rigid, or the animal is stinted within it, the insect throws it off and appears clothed anew; it then becomes larger and much whiter, though it has a greenish cast after some days, which are more or less according to the different heat of the climate, or to the quality of the food, it leaves off eating, and seems to sleep for two days together; then it begins to stir, and put itself into violent motions, till the skin falls off the second time, and is thrown aside by the animal's feet. All these changes are made in three weeks or a month's time, after which it begins to feed once more, still in its caterpillar form, but a good deal differing from itself before its change. In a few days' time it seems to sleep again; and, when it awakes, it again changes its clothing, and continues feeding as before. When it has thus taken a sufficiency of food, and its parts are disposed for assuming the aurelia form, the animal forsakes, for the last time, all food and society, and prepares itself a retreat to defend it from external injuries, while it is seemingly deprived of life and motion.

This retreat is no other than its cone, or ball of silk, which nature has taught it to compose with great art, and within which it buries itself, till it assumes its winged form. This cone or ball is spun from two little longish kinds of bags that lie above the intestines, and are filled with a gummy fluid, of a marigold colour. This is the substance of which the threads are formed; and the little animal is furnished with a surprising apparatus for spinning it to the degree of fineness which its occasions may require. This instrument in some measure resembles a wire-drawer's machine, in which gold or silver threads are drawn to any degree of minuteness; and through this the animal draws its thread with great assiduity. As every thread proceeds from two gum bags, it is probable that each supplies its own, which, however, are united as they proceed from the animal's body. If we examine the thread with a microscope, it will be found that it is flatted on one side, and grooved along its length; from whence we infer, that it is doubled just upon leaving the body, and that the two threads stick to each other by that gummy quality of which they are possessed. Previous to spinning its web, the silk-worm seeks out some convenient place to erect its cell, without any obstruction. When it has found a leaf, or a chink, fitted for its purpose, it begins to writhe its head in every direction, and fastens its thread on every side to the sides of its retreat. Though all its

first essays seem perfectly confused, yet they are not altogether without design: there appears, indeed, no order or contrivance in the disposal of its first threads; they are by no means laid artfully over each other, but are thrown out at random, to serve as an external shelter against rain; for nature having appointed the animal to work upon trees in the open air, its habits remain, though it is brought up in a warm apartment.

Malpighi pretends to have observed six different layers in a single cone of silk: but what may easily be observed is, that it is composed externally of a kind of rough cotton-like substance, which is called floss; within, the thread is more distinct and even; and next the body of the aurelia, the apartment seems lined with a substance of the hardness of paper, but of a much stronger consistence. It must not be supposed, that the thread which goes to compose the cone is rolled round, as we roll a bottom; on the contrary, it lies upon it in a very irregular manner, and winds off now from one side of the cone, and then from the other. This whole thread, if measured, will be found about three hundred yards long, and so very fine, that eight or ten of them are generally rolled off into one by the manufacturers. The cone, when completed, is in form like a pigeon's egg, and more pointed at one end than the other; at the smaller end, the head of the aurelia is generally found; and this is the place that the insect, when converted into a moth, is generally seen to burst through.

It is generally a fortnight or three weeks before the aurelia is changed into a moth; but no sooner is the winged insect completely formed, than, having divested itself of its aurelia skin, it prepares to burst through its cone, or outward prison: for this purpose it extends its head towards the point of the cone, butts with its eyes, which are rough, against the lining of its cell, wears it away, and at last pushes forward, through a passage which is small at first, but which enlarges as the animal increases its efforts for emancipation, while the tattered remnants of its aurelia skin lie in confusion within the cone, like a bundle of dirty linen.

The animal, when thus set set free from its double confinement, appears exhausted with fatigue, and seems produced for no other purpose but to transmit a future brood. It neither flies nor eats; the male only seeking the female, whose eggs he impregnates; and their union continues for four days without interruption. The male dies immediately after separation from his mate; and she survives him only till she has laid her eggs, which are not hatched into worms till the ensuing spring.

However, there are few of these animals suffered to come to a state of maturity; for as their bursting through the cone destroys the silk, the manufacturers take care to kill the aurelia, by exposing it to the sun, before the moth comes to perfection. This done, they take off the floss, and throw the cones into warm water, stirring them till the first thread offers them a clue for winding all off. They generally take eight of the silken threads together, but

the cones are still kept under water, till a proper quantity of the silk is wound off: however, they do not take all; for the latter parts grow weak, and are of a bad colour. As to the paper-like substance which remains, some stain it with a variety of colours to make artificial flowers, others let it die in the water, till the glutinous matter which cements it is all dissolved; it is then carded like wool, spun with a wheel, and converted into silk stuffs of an inferior kind.

PART IV.

INSECTS OF THE FOURTH ORDER.

CHAPTER I.

OF THE FOURTH ORDER OF INSECTS IN GENERAL.

In the foregoing part we treated of caterpillars changing into butterflies; in the present will be given the history of grubs changing into their corresponding winged animals. These, like the former, undergo their transformation, and appear as grubs or maggots, as aurelias, and at last as winged insects. Like the former, they are bred from eggs; they feed in their reptile state; they continue motionless and lifeless as aurelias, and fly and propagate, when furnished with wings. But they differ in many respects: the grub or maggot wants the number of feet which the caterpillar is seen to have; the aurelia is not so totally wrapped up but that its feet and its wings appear. The perfect animal, when emancipated, also has its wings either cased, or transparent like gauze; not coloured with that beautifully painted dust which adorns the wings of the butterfly.

In this class of insects, therefore, we may place a various tribe, that are first laid as eggs, then are excluded as maggots or grubs, then change into aurelias, with their legs and wings not wrapped up, but appearing; and lastly, assuming wings, in which state they propagate their kind. Some of these have four transparent wings, as bees; some have two membraneous cases to their wings, as beetles; and some have but two wings, which are transparent, as ants. Here, therefore, we will place the Bee, the Wasp, the Humble Bee, the Ichneumon Fly, the Gnat, the Tipula or Longlegs, the Beetle, the May Bug, the Glow-worm, and the Ant. The transformations which all these undergo are pretty nearly similar; and though very different animals in form, are yet produced nearly in the same manner.

CHAPTER II.

OF THE BEE.

To give a complete history of this insect in a few pages, which some have exhausted volumes in describing, and whose nature and properties still continue in dispute, is impossible. It will be sufficient to give a general idea of the animal's operations, which, though they have been studied for more than two thousand years, are still but incompletely known. The account given us by Reaumur is sufficiently minute; and, if true, sufficiently wonderful: but I find many of the facts which he relates doubted by those who are most conversant with bees; and some of them actually declared not to have a real existence in nature.

It is unhappy, therefore, for those whose method demands a history of bees, that they are unfurnished with those materials which have induced so many observers to contradict so great a naturalist. His life was spent in the contemplation; and it requires an equal share of attention to prove the error of his discoveries. Without entering, therefore, into the dispute, I will take him for my guide, and just mention, as I go along, those particulars in which succeeding observers have begun to think him erroneous. Which of the two are right, time only can discover; for my part, I have only heard one side, for as yet none have been so bold as openly to oppose Reaumur's delightful researches.

There are three different kinds of bees in every hive. First, the labouring bees, which make up the far greatest number, and are thought to be neither male nor female, but merely born for the purposes of labour, and continuing the breed, by supplying the young with provision while yet in their helpless state. The second sort are the drones; they are of a darker colour, longer, and more thick by one-third than the former: they are supposed to be the males, and there is not above a hundred of them in a hive of seven or eight thousand bees. The third sort is much larger than either of the former, and still fewer in number: some assert, that there is not above one in every swarm; but this later observers affirm not to be true, there being sometimes five or six in the same hive. These are called Queen Bees, and are said to lay all the eggs from which the whole swarm is hatched in a season.

In examining the structure of the common working bee, the first remarkable part that offers is the trunk, which serves to extract the honey from flowers. It is not formed, like that of other flies, in the manner of a tube, by which the fluid is to be sucked up, but like a beesom, to sweep, or a tongue, to lick it away. The animal is furnished also with teeth, which serve it in making wax. This substance is gathered from flowers, like honey; it consists of that dust or farina which contributes to the fecundation of plants, and is moulded into wax by the little animal at leisure.

Every bee, when it leaves the hive to collect this precious store, enters into the cup of the flower, particularly such as seem charged with the greatest quantities of this yellow farina. As the animal's body is covered over with hair, it rolls itself within the flower, and soon becomes quite covered with the dust, which it soon after brushes off with its two hind legs, and kneads into two little balls. In the thighs of the hind legs there are two cavities, edged with hair; and into these, as into a basket, the animal sticks its pellets. Thus employed, the bee flies from flower to flower increasing its store, and adding to its stock of wax, until the ball upon each thigh becomes as big as a grain of pepper: by this time, having got a sufficient load, it returns, making the best of its way to the hive.

The belly of the bee is divided into six rings, which sometimes shorten the body, by slipping one over the other. It contains within it, beside the intestines, the honey-bag, the venom-bag, and the sting. The honey-bag is as transparent as crystal, containing the honey that the bee has brushed from the flowers, of which the greater part is carried to the hive, and poured into the cells of the honey-comb, while the remainder serves for the bee's own nourishment; for during the summer it never touches what has been laid up for the winter. The sting, which serves to defend this little animal from its enemies, is composed of three parts; the sheath, and two darts, which are extremely small and penetrating. Both the darts have several points or barbs, like those of a fish-hook, which render the sting more painful, and makes the darts rankle in the wound. Still, however, this instrument would be very slight, did not the bee poison the wound. The sheath, which has a sharp point, makes the first impression, which is followed by that of the darts, and then the venomous liquor is poured in. The sheath sometimes sticks so fast in the wound, that the animal is obliged to leave it behind, by which the bee soon after dies, and the wound is considerably inflamed. It might at first appear well for mankind if the bee were without its sting; but upon recollection it will be found, that the little animal would then have too many rivals in sharing its labours. A hundred other lazy animals, fond of honey, and hating labour, would intrude upon the sweets of the hive, and the treasure would be carried off for want of armed guardians to protect it.

From examining the bee singly, we now come to consider it in society, as an animal not only subject to laws, but active, vigilant, laborious, and disinterested. All its provisions are laid up for the community, and all its arts in building a cell designed for the benefit of posterity. The substance with which bees build their cells is wax, which is fashioned into convenient apartments for themselves and their young. When they begin to work in their hives, they divide themselves into four companies, one of which roves in the fields in search of materials; another employs itself in laying out the bottom and partitions of their cells; a third is employed

in making the inside smooth from the corners and angles; and the fourth company bring food for the rest, or relieve those who return with their respective burdens. But they are not kept constant to one employment, they often change the tasks assigned them; those that have been at work being permitted to go abroad, and those that have been in the fields already, take their places. They seem even to have signs by which they understand each other; for when any of them wants food, it bends down its trunk to the bee from whom it is expected, which then opens its honey-bag, and lets some drops fall into the other's mouth, which is at that time opened to receive it. Their diligence and labour is so great, that in a day's time they are able to make cells, which lie upon each other, numerous enough to contain three thousand bees.

If we examine their cells, they will be found formed in the exactest proportion. It was said by Pappus, an ancient geometrician, that, of all other figures, hexagons were the most convenient; for, when placed touching each other, the most convenient room would be given, and the smallest lost. The cells of the bees are perfect hexagons; these in every honeycomb are double, opening on either side, and closed at the bottom. The bottoms are composed of little triangular panes, which, when united together, terminate in a point, and lie exactly upon the extremities of other panes of the same shape, in opposite cells. These lodgings have spaces like streets between them, large enough to give the bees a free passage in and out, and yet narrow enough to preserve the necessary heat. The mouth of every cell is defended by a border, which makes the door a little less than the inside of the cell, which serves to strengthen the whole. These cells serve for different purposes: for laying up their young; for their wax, which in winter becomes a part of their food; and for their honey, which makes their principal subsistence.

It is well known that the habitation of bees ought to be very close; and what their hives want from the negligence or unskilfulness of man, these animals supply by their own industry; so that it is their principal care, when first hived, to stop up all the crannies. For this purpose they make use of a resinous gum, which is more tenacious than wax, and differs greatly from it. This the ancients called *propolis:* it will grow considerably hard in June, though it will in some measure soften by heat; and is often found different in consistence, colour, and smell. It has generally an agreeable aromatic odour when it is warmed; and by some it is considered as a most grateful perfume. When the bees begin to work with it, it is soft, but it acquires a firmer consistence every day, till at length it assumes a brown colour, and becomes much harder than wax. The bees carry it on their hinder legs; and some think it is met with on the birch, the willow, and poplar. However it is procured, it is certain that they plaster the inside of their hives with this composition.

If examined through a glass hive, from the hurry the whole

swarm is in, the whole appears at first like anarchy and confusion; but the spectator soon finds every animal diligently employed, and following one pursuit with a settled purpose. Their teeth are the instruments by which they model and fashion their various buildings, and give them such symmetry and perfection. They begin at the top of the hive, and several of them work at a time at the cells, which have two faces. If they are stinted with regard to time, they give the new cells but half the depth which they ought to have, leaving them imperfect till they have sketched out the number of cells necessary for the present occasion. The construction of their combs costs them a great deal of labour; they are made by insensible additions, and not cast at once in a mould, as some are apt to imagine. There seems no end of their shaping, finishing, and turning them neatly up. The cells of their young are most carefully formed; those designed for lodging the drones are larger than the rest, and that for the queen-bee the largest of all. The cells in which the young brood are lodged, serve at different times for containing honey; and this proceeds from an obvious cause: every worm, before it is transformed into an aurelia, hangs its old skin on the partition of its cell; and thus, while it strengthens the wall, diminishes the capacity of its late apartment. The same cell, in a single summer, is often tenanted by three or four worms in succession, and the next season by three or four more. Each worm takes particular care to fortify the pannels of its cell, by hanging up its spoils there: thus the partitions being lined six or eight deep, become at last too narrow for a new brood, and are converted into store-houses for honey.

Those cells where nothing but honey is deposited, are much deeper than the rest. When the harvest of honey is so plentiful that they have not sufficient room for it, they either lengthen their combs or build more, which are much longer than the former. Sometimes they work at three combs at a time; for when there are three work-houses, more bees may be thus employed, without embarrassing each other.

But honey, as was before observed, is not the only food upon which these animals subsist. The meal of flowers of which their wax is formed, is one of their most favourite repasts. This is a diet which they live upon during the summer, and of which they lay up a large winter provision. The wax of which their combs are made is no more than this meal digested, and wrought into a paste. When the flowers upon which bees generally feed are not fully blown, and this meal or dust is not offered in sufficient quantities, the bees pinch the tops of the stamina in which it is contained with their teeth, and thus anticipate the progress of vegetation. In April and May the bees are busy from morning to evening in gathering this meal; but when the weather becomes too hot in the midst of summer, they work only in the morning.

The bee is furnished with a stomach for its wax, as well as its honey. In the former of the two, their powder is altered, digested,

and concocted into real wax, and is thus ejected by the same passage by which it was swallowed. Every comb newly made is white; but it becomes yellow as it grows old, and almost black when kept too long in the hive. Besides the wax thus digested, there is a large portion of the powder kneaded up for food in every hive, and kept in separate cells for winter provision. This is called by the country people *bee-bread*, and contributes to the health and strength of the animal during winter. Those who rear bees may rob them of their honey, and feed them during the winter with treacle; but no proper substitute has yet been found for the bee-bread, and without it the animals become consumptive, and die.

As for the honey, it is extracted from that part of the flower called the *nectareum*. From the mouth this delicious fluid passes into the gullet, and then into the first stomach or honey-bag, which when filled appears like an oblong bladder. Children that live in country places are well acquainted with this bladder, and destroy many bees to come at their store of honey. When a bee has sufficiently filled his first stomach, it returns back to the hive, where it disgorges the honey into one of the cells. It often happens that the bee delivers its store to some other at the mouth of the hive, and flies off for a fresh supply. Some honeycombs are always left open for common use, but many others are stopped up till there is a necessity of opening them. Each of these is covered carefully with wax, so close, that the covers seem to be made at the very instant the fluid is deposited within them.

Having thus given a cursory description of the insect, individually considered, and of the habitation it forms, we next come to its social habits and institutions; and in considering this little animal attentively, after the necessary precautions for the immediate preservation of the community, its second care is turned to the continuance of posterity. How numerous soever the multitude of bees may appear in one swarm, yet they all owe their origin to a single parent, which is called the Queen-Bee. It is indeed surprising that a single insect shall in one summer give birth to above twenty thousand young; but upon opening her body the wonder will cease, as the number of eggs appearing at one time amounts to five thousand. This animal, whose existence is of such importance to her subjects, may easily be distinguished from the rest by her size, and the shape of her body. On her safety depends the whole welfare of the commonwealth; and the attention paid her by all the rest of the swarm, evidently show the dependance her subjects have upon her security. If this insect be carefully observed, she will be seen at times attended with a numerous retinue, marching from cell to cell, plunging the extremity of her body into many of them, and leaving a small egg in each.

The bees which generally compose her train are thought to be males, which serve to impregnate her by turns. These are larger and blacker than the common bees, without stings and without

industry. They seem formed only to transmit a posterity, and to attend the queen whenever she thinks proper to issue from the secret retreats of the hive, where she most usually resides. Upon the union of these two kinds depends all expectations of a future progeny, for the working bees are of no sex, and only labour for another offspring; yet such is their attention to their queen, that if she happens to die, they will leave off working, and take no farther care of posterity. If, however, another queen is, in this state of universal despair, presented them, they immediately acknowledge her for their sovereign, and once more diligently apply to their labour. It must be observed, however, that all this fertility of the queen-bee, and the great attentions paid to her by the rest, are controverted by more recent observers. They assert that the common bees are parents themselves; that they deposit their eggs in the cells which they have prepared; that the females are impregnated by the males, and bring forth a progeny which is wholly their own.

However, to go on with their history, as delivered us by M. Reaumur:—When the queen-bee has deposited the number of eggs necessary in the cells, the working bees undertake the care of the rising posterity. They are seen to leave off their usual employments, to construct proper receptacles for eggs, or to complete those that are already formed. They purposely build little cells, extremely solid, for the young, in which they employ a great deal of wax; those designed for lodging the males, as was already observed, are larger than the rest, and those for the queen-bees the largest of all. There is usually but one egg deposited in every cell; but when the fecundity of the queen is such that it exceeds the number of cells already prepared, there are sometimes three or four eggs crowded together in the same apartment. But this is an inconvenience that the working bees will by no means suffer. They seem sensible, that two young ones stuffed up in the same cell, when they grow larger, will but embarrass, and at last destroy each other; they therefore take care to leave a cell to every egg, and remove or destroy the rest.

The single egg that is left remaining is fixed to the bottom of the cell, and touches it but in a single point. A day or two after it is deposited the worm is excluded from the shell of the egg, having the appearance of a maggot rolled up in a ring, and lying softly on a bed of whitish-coloured jelly, upon which also the little animal begins to feed. In the mean time, the instant it appears, the working bees attend it with the most anxious and parental tenderness; they furnish it every hour with a supply of this whitish substance, on which it feeds and lies, and watch the cell with unremitting care. They are nurses that have greater affection for the offspring of others than many parents have for their own children. They are constant in visiting each cell, and seeing that nothing is wanting, preparing the white mixture, which is nothing but a composition of honey and wax, in their own bowels,

with which they feed them. Thus attended, and plentifully fed, the worm, in less than six days' time, comes to its full growth, and no longer accepts the food offered it. When the bees perceive that it has no further occasion for feeding, they perform the last offices of tenderness, and shut the little animal up in its cell, walling up the mouth of its apartment with wax; there they leave the worm to itself, having secured it from every external injury.

The worm is no sooner left enclosed, but, from a state of inaction, it begins to labour, extending and shortening its body; and by this means lining the walls of its apartment with a silken tapestry, which it spins in the manner of caterpillars before they undergo their last tranformation. When their cell is thus prepared, the animal is soon after transformed into an aurelia; but differing from that of the common caterpillar, as it exhibits not only the legs, but the wings of the future bee, in its present state of inactivity. Thus, in about twenty or one-and-twenty days after the egg was laid, the bee is completely formed, and fitted to undergo the fatigues of its state. When all their parts have acquired their proper strength and consistence, the young animal opens its prison, by piercing with its teeth the waxen door that confines it. When just freed from its cell, it is as yet moist, and incommoded with the spoils of its former situation: but the officious bees are soon seen to flock round it, and to lick it clean on both sides with their trunks; while another band, with equal assiduity, are observed to feed it with honey; others again begin immediately to cleanse the cell that has been just left, to carry the ordures out of the hive, and to fit the place for a new inhabitant. The young bee soon repays their care by its industry; for as soon as ever its external parts become dry, it discovers its natural appetites for labour, and industriously begins the task, which it pursues unremitting through life. The toil of man is irksome to him, and he earns his subsistance with pain; but this little animal seems happy in its pursuits, and finds delight in all its employments.

When just freed from the cell, and properly equipped by its fellow-bees for duty, it at once issues from the hive, and, instructed only by nature, goes in quest of flowers, chooses only those that yield it a supply, rejects such as are barren of honey, or have been already drained by other adventurers; and when loaded, is never at a loss to find its way back to the common habitation. After this first sally, it begins to gather the mealy powder that lies on every flower, which is afterwards converted into wax; and with this, the very first day, it returns with two large balls stuck to its thighs.

When bees first begin to break their prisons, there are generally above a hundred excluded in one day. Thus, in the space of a few weeks, the number of the inhabitants in one hive, of moderate size, becomes so great, that there is no place to contain the new comers; and they are scarcely excluded from the cell, when they are obliged by the old bees to sally forth in quest of new habita-

tions. In other words, the hive begins to swarm, and the new progeny prepares for exile.

While there is room enough in the hive, the bees remain quietly together; it is necessity alone that compels the separation. Sometimes, indeed, the young brood, with graceless obstinacy, refuse to depart, and even venture to resist their progenitors. The young ones are known by being browner than the old, with whiter hair; the old ones are of a lighter colour, with red hair. The two armies are therefore easily distinguishable, and dreadful battles are often seen to ensue. But the victory almost ever terminates with strict poetical justice in favour of the veterans, and the rebellious offspring are driven off, not without loss and mutilation.

In different countries the swarms make their appearance at different times of the year, and there are several signs previous to this intended migration. The night before, an unusual buzzing is heard in the hive; in the morning, though the weather be soft and inviting, they seem not to obey the call, being intent on more important meditations within. All labour is discontinued in the hive, every bee is either employed in forcing, or reluctantly yielding a submission; at length after some noise and tumult, a queen-bee is chosen, to guard, rather than conduct, the young colony to other habitations, and then they are marshalled without any apparent conductor. In less than a minute they leave their native abode, and forming a cloud round their protectress, they set off, without seeming to know the place of their destination; *The world before them, where to choose their place of rest.* The usual time of swarming is from ten in the morning to three in the afternoon, when the sun shines bright, and invites them to seek their fortunes. They flutter for a while in the air, like flakes of snow, and sometimes undertake a distant journey, but more frequently are contented with some neighbouring asylum—the branch of a tree, a chimney top, or some other exposed situation. It is, indeed, remarkable, that all those animals, of whatever kind, that have long been under the protection of man, seem to lose a part of their natural sagacity in providing for themselves. The rabbit, when domesticated, forgets to dig holes, the hen to build a nest, and the bee to seek a shelter that shall protect it from the inclemencies of winter. In those countries where the bees are wild, and unprotected by man, they are always sure to build their waxen cells in the hollow of a tree; but with us, they seem improvident in their choice, and the first green branch that stops their flight, seems to be thought sufficient for their abode through the winter. However, it does not appear that the queen chooses the place where they are to alight, for many of the stragglers, who seem to be pleased with a particular branch, go and settle upon it; others are seen to succeed; and at last the queen herself, when she finds a sufficient number there before her, goes to make it the place of her head-quarters. When the queen is settled, the rest of the swarm soon follow, and in about a quarter of an hour the whole body seem to be at ease. It some-

times is found, that there are two or three queens to a swarm, and the colony is divided into parties; but it most usually happens that one of these is more considerable than the other, and the bees by degrees desert the weakest to take shelter under the most powerful protector. The deserted queen does not long survive this defeat; she takes refuge under the new monarch, and is soon destroyed by her jealous rival. Till this cruel execution is performed, the bees never go out to work; and if there should be a queen-bee belonging to the new colony left in the old hive, she always undergoes the fate of the former. However, it must be observed, that the bees never sacrifice any of their queens when the hive is full of wax and honey; for there is at that time no danger in maintaining a plurality of breeders.

When the swarm is thus conducted to a place of rest, and the policy of government is settled, the bees soon resume their former labours. The making cells, storing them with honey, impregnating the queen, making proper cells for the reception of the rising progeny, and protecting them from external danger, employ their unceasing industry. But soon after, and towards the latter end of summer, when the colony is sufficiently stored with inhabitants, a most cruel policy ensues. The drone bees, which are (as has been said) generally in a hive to the number of a hundred, are marked for slaughter. These, which had hitherto led a life of indolence and pleasure, whose only employment was in impregnating the queen, and rioting upon the labours of the hive, without aiding in the general toil, now share the fate of most voluptuaries, and fall a sacrifice to the general resentment of society.

The working bees in a body declare war against them; and in two or three days' time the ground all around the hive is covered with their dead bodies. Nay, the working bees will even kill such drones as are yet in the worm state in the cell, and eject their bodies from the hive among the general carnage.

When a hive sends out several swarms in the year, the first is always the best and the most numerous. These having the whole summer before them, have the more time for making wax and honey, and consequently their labours are the most valuable to the proprietor. Although the swarm chiefly consist of the youngest bees, yet it is often found that bees of all ages compose the multitude of emigrants, and it often happens that bees of all ages are seen remaining behind. The number of them is always more considerable than that of some populous cities, for sometimes upwards of forty thousand are found in a single hive. So large a body may well be supposed to work with great expedition: and in fact, in less than twenty-four hours they will make combs above twenty inches long, and seven or eight broad. Sometimes they will half fill their hives with wax in less than five days. In the first fifteen days, they are always found to make more wax than they do afterwards during the rest of the year.

Such are the outlines of the natural history of these animals, as

usually found in our own country. How they are treated, so as to produce the greatest quantity of honey, belongs rather to the rural economist than the natural historian; volumes have been written on the subject, and still more remains, equally curious and new. One thing, however, it may be proper to observe, that a farm or a country may be overstocked with bees, as with any other sort of animal; for a certain number of hives always require a certain number of flowers to subsist on. When the flowers near home are rifled, then are these industrious insects seen taking more extensive ranges: but their abilities may be over-taxed; and if they are obliged, in quest of honey, to go too far from home, they are over-wearied in the pursuit, they are devoured by birds, or beat down by the winds and rain.

From a knowledge of this, in some parts of France and Piedmont, they have contrived, as I have often seen, a kind of floating bee-house.

They have on board one barge threescore or a hundred bee-hives, well defended from the inclemency of an accidental storm; and with these the owners suffer themselves to float gently down the river. As the bees are continually choosing their flowery pasture along the banks of the stream, they are furnished with sweets before unrifled; and thus a single floating bee-house yields the proprietor a considerable income. Why a method similar to this has never been adopted in England, where we have more gentle rivers, and more flowery banks than in any other part of the world, I know not; certainly it might be turned to advantage, and yield the possessor a secure, though perhaps a moderate income.

Having mentioned the industry of these admirable insects, it will be proper to say something of the effects of their labour—of that wax and honey which are turned by man to such various uses. Bees gather two kinds of wax, one coarse and the other fine. The coarser sort is bitter, and with this, which is called *propolis*, they stop up all the holes and crevices of their hives. It is of a more resinous nature than the fine wax, and is consequently better qualified to resist the moisture of the season, and preserve the works warm and dry within. The fine wax is as necessary to the animal's preservation as the honey itself. With this they make their lodgings, with this they cover the cells of their young, and in this they lay up their magazines of honey. This is made, as has been already observed, from the dust of flowers, which is carefully kneaded by the little insect, then swallowed, and having undergone a kind of digestion, is formed into the cells which answer such a variety of purposes. To collect this, the animal rolls itself in the flower it would rob, and thus takes up the vegetable dust with the hair of its body. Then carefully brushing it into a lump with its fore-paws, it thrusts the composition into two cavities behind the thighs, which are made like spoons to receive the wax, and the hair that lines them serves to keep it from falling.

As of wax, there are also two kinds of honey, the white and the yellow. The white is taken without fire from the honeycombs:

The yellow is extracted by heat, and squeezed through bags in a press. The best honey is new, thick, and granulated, of a clear transparent white colour, of a soft and aromatic smell, and of a sweet and lively taste. Honey made in mountainous countries is preferable to that of the valley. The honey made in the spring is more highly esteemed than that gathered in summer; which last is still more valuable than that of autumn, when the flowers begin to fade and lose their fragrance,

The bees are nearly alike in all parts of the world, yet there are differences worthy our notice. In Gaudaloupe, the bee is less by one-half than the European, and more black and round. They have no sting, and make their cells in hollow trees, where, if the hole they meet with is too large, they form a sort of waxen house, of the shape of a pear, and in this they lodge and store their honey, and lay their eggs. They lay up their honey in waxen vessels, of the size of a pigeon's egg, of a black or deep violet colour; and these are so joined together, that there is no space left between them. The honey never congeals, but is fluid, of the consistence of oil, and the colour of amber. Resembling these, there are found little black bees, without a sting, in all the tropical climates; and though these countries are replete with bees like our own, yet those form the most useful and laborious tribe in that part of the world. The honey they produce is neither so unpalatable nor so surfeiting as ours, and the wax is so soft, that it is only used for medicinal purposes, it being never found hard enough to form into candles, as in Europe.

Of insects that receive the name of bees, among us there are several, which, however, differ widely from that industrious social race we have been just describing. The Humble-Bee is the largest of all this tribe, being as large as the first joint of one's middle finger. These are seen in every field, and perched on every flower. They build their nest in holes in the ground, of dry leaves mixed with wax and wool, defended with moss from the weather. Each humble-bee makes a separate cell, about the size of a small nutmeg, which is round and hollow, containing the honey in a bag. Several of these cells are joined together, in such a manner that the whole appears like a cluster of grapes. The females, which have the appearance of wasps, are very few, and their eggs are laid in cells, which the rest soon cover over with wax. It is uncertain whether they have a queen or not; but there is one much larger than the rest, without wings and without hair, and all over black, like polished ebony. This goes and views all the works from time to time, and enters into the cell, as if it wanted to see whether every thing was done right: in the morning the young humble-bees are very idle, and seem not at all inclined to labour, till one of the largest, about seven o'clock, thrusts half its body from a hole designed for that purpose, and, seated on the top of the nest, beats its wings for twenty minutes successively, buzzing the whole time, till the whole colony is put in motion. The humble-bees gather honey,

as well as the common bees; but it is neither so fine nor so good, nor the wax so clean or so capable of fusion.

Besides the bees already mentioned, there are various kinds among us, that have much the appearance of honey-makers, and yet make only wax. The Wood-Bee is seen in every garden. It is rather larger than the common queen-bee; its body of a bluish-black, which is smooth and shining. It begins to appear at the approach of spring, and is seen flying near walls exposed to a sunny aspect. This bee makes its nest in some piece of wood, which it contrives to scoop and hollow for its purpose. This, however, is never done in trees that are standing, for the wood it makes choice of is half rotten. The holes are not made directly forward, but turning to one side, and have an opening sufficient to admit one's middle finger, from whence runs the inner apartment, generally twelve or fifteen inches long. The instruments used in boring these cavities are their teeth: the cavity is usually branched into three or four apartments, and in each of these they lay their eggs, to the number of ten or twelve, each separate and distinct from the rest. The egg is involved in a sort of paste, which serves at once for the young animal's protection and nourishment. The grown bees, however, feed upon small insects, particularly a louse of a reddish-brown colour, of the size of a small pin's head.

Mason-Bees make their cells with a sort of mortar, made of earth, which they build against a wall that is exposed to the sun. The mortar, which at first is soft, soon becomes as hard as stone, and in this their eggs are laid. Each nest contains seven or eight cells, an egg in every cell, placed regularly one over the other. If the nest remains unhurt, or wants but little repairs, they make use of them the year ensuing; and thus they often serve three or four years successively. From the strength of their houses, one would think these bees in perfect security, yet none are more exposed than they. A worm with very strong teeth is often found to bore into their little fortifications, and devour their young.

The Ground-Bee builds its nest in the earth, wherein they make round holes, five or six inches deep, the mouth being narrow, and only just sufficient to admit the little inhabitant. It is amusing enough to observe the patience and assiduity with which they labour. They carry out all the earth, grain by grain, to the mouth of the hole, where it forms a little hillock, an Alps compared to the power of the artist by which it is raised. Sometimes the walks of a garden are found undermined by their labonrs; some of the holes running directly downward, others horizontally beneath the surface. They lay up in these cavities provisions for their young, which consist of a paste that has the appearance of corn, and is of a sweetish taste.

The Leaf-cutting Bees make their nest and lay their eggs among bits of leaves, very artificially placed in holes in the earth, of about the length of a tooth-pick case. They make the bits of leaves of a

roundish form, and with them line the inside of their habitations. This tapestry is still further lined by a reddish kind of paste, somewhat sweet or acid. These bees are of various kinds; those that build their nests with chesnut leaves are as big as drones, but those of the rose tree are smaller than the common bee.

The Wall-Bees are so called because they make their nest in walls, of a kind of silky membrane with which they fill up the vacuities between the small stones which form the sides of their habitation. Their apartment consists of several cells, placed end to end, each in the shape of a woman's thimble. Though the web which lines this habitation is thick and warm, yet it is transparent and of a whitish colour. This substance is supposed to be spun from the animal's body. The males and females are of a size, but the former are without a sting. To these varieties of the bee kind might be added several others, which are all different in nature, but not sufficiently distinguished to excite curiosity.

CHAPTER III.

OF THE WASP.

HOWEVER similar many insects may be in appearance, this does not imply a similitude in their history. The bee and wasp resemble each other very strongly, yet, in examining their manner and their duration, they differ very widely: the bee labours to lay up honey, and lives to enjoy the fruits of its industry; the wasp appears equally assiduous, but only works for posterity, as the habitation is scarcely completed when the inhabitant dies.

The Wasp is well known to be a winged insect with a sting, to be longer in proportion to its bulk than the bee, to be marked with bright yellow circles round its body, and to be the most swift and active insect of all the fly kind. On each side of the mouth this animal is furnished with a long tooth, notched like a saw; and with these it is enabled to cut any substance, not omitting meat itself, and to carry it to its nest. Wasps live like bees in community, and sometimes ten or twelve thousand are found inhabiting a single nest.

Of all other insects the wasp is the most fierce, voracious, and most dangerous when enraged. They are seen wherever flesh is cutting up, gorging themselves with the spoil, and then flying to their nests with their reeking prey. They make war also on every other fly, and the spider himself dreads their approaches.

Every community among bees is composed of females or queens, drones or males, and neutral or working bees. Wasps have similar occupations; the two first are for propagating the species, the last for nursing, defending, and supporting the rising progeny. Among

bees, however, there is seldom above a queen or two in a hive; among wasps there are above two or three hundred.

As soon as the summer begins to invigorate the insect tribes, the wasps are the most of the number, and diligently employed either in providing provisions for their nest, if already made, or in making one if the former habitation be too small to receive the increasing community. The nest is one of the most curious objects in natural history, and contrived almost as artificially as that of the bees themselves. Their principal care is to seek out a hole that has been begun by some other animal, a field mouse, a rat, or a mole, to build their nests in. They sometimes build upon the plain, where they are sure of the dryness of their situation, but most commonly on the side of a bank, to avoid the rain or water that would otherwise annoy them. When they have chosen a proper place, they go to work with wonderful assiduity. Their first labour is to enlarge and widen the hole, taking away the earth and carrying it off to some distance. They are perfectly formed for labour, being furnished with a trunk above their mouths, two saws on each side, which play to the right and left against each other, and six strong muscular legs to support them. They cut the earth into small parcels with their saws, and carry it out with their legs or paws. This is the work of some days; and at length the outline of their habitation is formed, making a cavity of about a foot and a half every way. While some are working in this manner, others are roving the fields to seek out materials for their building. To prevent the earth from falling down and crushing their rising city into ruin, they make a sort of roof with their gluey substance, to which they begin to fix the rudiments of their building, working from the top downwards, as if they were hanging a bell, which, however, at length they close at the bottom. The materials with which they build their nests are bits of wood and glue. The wood they get where they can, from the rails and posts which they meet with in the fields and elsewhere. These they saw and divide into a multitude of small fibres of which they take up little bundles in their claws, letting fall upon them a few drops of gluey matter with which their bodies are provided, by the help of which theyknead the whole composition into a paste, which serves them in their future building. When they have returned with this to their nest, they stick their load of paste on that part where they make their walls and partitions; they tread it close with their feet, and trowel it with their trunks, still going backwards as they work. Having repeated this operation three or four times, the composition is at length flatted out until it becomes a small leaf of a grey colour, much finer than paper, and of a pretty firm texture. This done, the same wasp returns to the field to collect a second load of paste, repeating the same several times, placing layer upon layer, and strengthening every partition in proportion to the wants or convenience of the general fabric. Other working wasps come quickly after to repeat the same operation, laying more leaves upon the former, till

at length, after much toil, they have finished the large roof which is to secure them from the tumbling in of the earth. This dome being finished, they make another entrance to their habitation, designed either for letting in the warmth of the sun, or for escaping in case one door be invaded by plunderers. Certain however it is, that by one of these they always enter, by the other they sally forth to their toil, each hole being so small that they can pass but one at a time. The walls being thus composed, and the whole somewhat of the shape of a pear, they labour at their cells, which they compose of the same paper-like substance that goes to the formation of the outside works. Their combs differ from those of bees, not less in the composition than the position which they are always seen to obtain. The honey-comb of the bee is edgeways with respect to the hive; that of the wasp is flat, and the mouth of every cell opens downwards. Thus is their habitation contrived, story above story, supported by several rows of pillars, which give firmness to the whole building, while the upper story is flat roofed, and as smooth as the pavement of a room laid with squares of marble. The wasps can freely walk upon these stories between the pillars, to do whatever their wants require. The pillars are very hard and compact, being larger at each end than in the middle, not much unlike the columns of a building. All the cells of the nest are only destined for the reception of the young, being replete with neither wax nor honey.

Each cell is, like that of the bee, hexagonal; but they are of two sorts, the one larger, for the production of the male and female wasps, the other less, for the reception of the working part of the community. When the females are impregnated by the males, they lay their eggs, one in each cell, and stick it in with a kind of gummy matter to prevent its falling out. From this egg proceeds the insect in its worm state, of which the old ones are extremely careful, feeding it from time to time till it becomes large, and entirely fills up its cell. But the wasp community differs from that of the bee in this, that among the latter the working bees take the parental duties upon them, whereas among the wasps the females alone are permitted to feed their young, and to nurse their rising progeny. For this purpose, the female waits with great patience till the working wasps have brought in their provisions, which she takes from them, and cuts into pieces. She then goes with great composure from cell to cell, and feeds every young one with her mouth. When the young worms have come to a certain size, they leave off eating, and begin to spin a very fine silk, fixing the first end to the entrance of the cell; then turning their heads first on one side, then on the other, they fix the thread to different parts, and thus they make a sort of a door which serves to close up the mouth of the cell. After this they divest themselves of their skins after the usual mode of transformation; the aurelia by degrees begins to emancipate itself from its shell; by little and

little it thrusts out its legs and wings, and insensibly acquires the colour and shape of its parent.

The wasp thus formed and prepared for depredation, becomes a bold, troublesome, and dangerous insect: there are no dangers which it will not encounter in pursuit of its prey, and nothing seems to satiate its gluttony. Though it can gather no honey of its own, no animal is more fond of sweets. For this purpose, it will pursue the bee and the humble-bee, destroy them with its sting, and then plunder them of their honey-bag, with which it flies triumphantly loaded to its nest to regale its young. Wasps are ever fond of making their nests in the neighbourhood of bees, merely to have an opportunity of robbing their hives and feasting on the spoil. Yet the bees are not found always patiently submissive to their tyranny, but fierce battles are sometimes seen to ensue, in which the bees make up by conduct and numbers what they want in personal prowess. When there is no honey to be had, they seek for the best and sweetest fruits, and they are never mistaken in their choice. From the garden they fly to the city, to the grocers' shops and butchers' shambles. They will sometimes carry off bits of flesh half as big as themselves, with which they fly to their nest for the nourishment of their brood. Those who cannot drive them away, lay for them a piece of ox's liver, which being without fibres, they prefer to other flesh; and wherever they are found, all other flies are seen to desert the place immediately. Such is the dread with which these little animals impress all the rest of the insect tribes, which they seize and devour without mercy, that they vanish at their approach. Wherever they fly, like the eagle or the falcon, they form a desert in the air around them. In this manner the summer is passed in plundering the neighbourhood, and rearing up their young; every day adds to their numbers; and from their strength, agility, and indiscriminate appetite for every kind of provision, were they as long-lived as the bee, they would soon swarm upon the face of nature, and become the most noxious plague of man; but providentially their lives are measured to their mischief, and they live but a single season.

While the summer heats continue, they are bold, voracious, and enterprising; but as the sun withdraws, it seems to rob them of their courage and activity. In proportion as the cold increases, they are seen to become more domestic; they seldom leave the nest, they make but short adventures from home, they flutter about in the noon-day heats, and soon after return chilled and feeble.

As their calamities increase, new passions soon begin to take place: the care for posterity no longer continues, and as the parents are no longer able to provide their growing progeny a supply, they take the barbarous resolution of sacrificing them all to the necessity of the times. In this manner, like a garrison upon short allowance, all the useless hands are destroyed; the young worms, which a little before they fed and protected with so much assiduity, are now butchered and dragged from their cells. As the cold increases,

they no longer find sufficient warmth in their nests, which grow hateful to them, and they fly to seek it in the corners of houses, and places that receive an artificial heat. But the winter is still insupportable, and, before the new year begins, they wither and die; the working wasps first, the males soon following, and many of the females suffer in the general calamity. In every nest, however, one or two females survive the winter, and having been impregnated by the male during the preceding season, she begins in spring to lay her eggs in a little hole of her own contrivance. This bundle of eggs, which is clustered together like grapes, soon produces two worms, which the female takes proper precaution to defend and supply, and these when hatched soon give assistance to the female, who is employed in hatching two more; these also gathering strength, extricate themselves out of the web that enclosed them, and become likewise assistants to their mother; fifteen days after, two more make their appearance: thus is the community every day increasing, while the female lays in every cell, first a male and then a female. These soon after become breeders in turn, till, from a single female, ten thousand wasps are seen produced before the month of June. After the female has thus produced her progeny, which are distributed in different districts, they assemble from all parts, in the middle of summer, and provide for themselves the large and commodious habitation which has been described above.

Such is the history of the social wasp; but, as among bees, so also among these insects, there are various tribes that live in solitude; these lay their eggs in a hole for the purpose, and the parent dies long before the birth of its offspring. In the principal species of the Solitary Wasps, the insect is smaller than the working wasp of the social kind. The filament, by which the corslet is joined to the body, is longer and more distinctly seen, and the whole colour of the insect is blacker than in the ordinary kinds. But it is not their figure, but the manners of this extraordinary insect, that claim our principal regard.

From the end of May to the beginning of July, this wasp is seen most diligently employed. The whole purpose of its life seems to be in contriving and fitting up a commodious apartment for its young one, which is not to succeed it till the year ensuing. For this end it is employed, with unwearied assiduity, in boring a hole into the finest earth some inches deep, but not much wider than the diameter of its own body. This is but a gallery leading to a wider apartment, destined for the convenient lodgment of its young. As it always chooses a gravelly soil to work in, and where the earth is almost as hard as stone itself, the digging and hollowing this apartment is an enterprise of no small labour. For effecting its operations, this insect is furnished with two teeth, which are strong and firm, but not sufficiently hard to penetrate the substance through which it is resolved to make its way: in order therefore to soften that earth which it is unable to pierce, it is furnished with a gummy liquor, which it emits upon the place, and which renders it more

easily separable from the rest; and the whole becoming a kind of soft paste, is removed to the mouth of the habitation. The animal's provision of liquor in these operations is however soon exhausted; and it is then seen taking up water either from some neighbouring flower or stream, in order to supply the deficiency.

At length, after much toil, a hole some inches deep is formed, at the bottom of which is a large cavity; and to this no other hostile insect would venture to find its way, from the length and the narrowness of the defile through which it would be obliged to pass. In this the solitary wasp lays its egg, which is destined to continue the species; there the nascent animal is to continue for above nine months, unattended and immured, and at first appearance the most helpless insect of the creation. But when we come to examine, new wonders offer; no other insect can boast so copiously luxurious a provision, or such confirmed security.

As soon as the mother-wasp has deposited her egg at the bottom of the hole, her next care is to furnish it with a supply of provisions, which may be offered to the young insect as soon as it leaves the egg. To this end she procures a number of little green worms, generally from eight to twelve, and these are to serve as food for the young one the instant it awakens into life. When this supply is regularly arranged and laid in, the old one then, with as much assiduity as it before worked out its hole, now closes the mouth of the passage; and thus leaving its young one immured in perfect security, and in a copious supply of animal food, she dies satisfied with having provided for a future progeny.

When the young one leaves the egg it is scarcely visible, and is seen immured among a number of insects, infinitely larger than itself, ranged in proper order around it, which, however, give it no manner of apprehension. Whether the parent, when she laid in the insect provision, contrived to disable the worms from resistance, or whether they are at first incapable of any, is not known. Certain it is, that the young glutton feasts upon the living spoil without any controul: his game lies at hand, and he devours one after the other as the calls of appetite incite him. The life of the young animal is therefore spent in the most luxurious manner, till its whole stock of worms is exhausted, and then the time of its transformation begins to approach; and then spinning a silken web, it continues fixed in its cell till the sun calls it from its dark abode the ensuing summer.

The wasps of Europe are very mischievous, yet they are innocence itself when compared to those of the tropical climates, where all the insect tribes are not only numerous, but large, voracious, and formidable. Those of the West Indies are thicker, and twice as long as the common bee; they are of a grey colour, striped with yellow, and armed with a very dangerous sting. They make their cells in the manner of a honey-comb, in which the young ones are hatched and bred. They generally hang their nests by threads, composed of the same substance with the cells, to the

branches of trees, and the eaves of houses. They are seen everywhere in great abundance, descending like fruit, particularly pears, of which shape they are, and as large as one's head. The inside is divided into three round stories, full of cells, each hexagonal, like those of a honey-comb. In some of the islands, these insects are so very numerous that their nests are stuck up in this manner scarcely two feet asunder, and the inhabitants are in continual apprehension from their accidental resentment. It sometimes happens that no precautions can prevent their attacks, and the pain of their sting is almost insupportable. Those who have felt it think it more terrible than even that of a scorpion; the whole visage swells, and the features are so disfigured that a person is scarcely known by his most intimate acquaintance.

CHAPTER IV.

OF THE ICHNEUMON FLY.

EVERY rank of insects, how voracious soever, have enemies that are terrible to them, and that revenge upon them the injuries done upon the rest of the animated creation. The wasp, as we have seen, is very troublesome to man, and very formidable to the insect tribe; but the Ichneumon Fly (of which there are many varieties) fears not the wasp itself; it enters its retreats, plunders its habitations, and takes possession of that cell for its own young, which the wasp had laboriously built for a dearer posterity.

Though there are many different kinds of this insect, yet the most formidable, and that best known, is called the Common Ichneumon, with four wings, like the bee, a long slender black body, and a three-forked tail, consisting of bristles, the two outermost black and the middlemost red. This fly receives its name from the little quadruped which is found to be so destructive to the crocodile, as it bears a strong similitude in its courage and rapacity.

Though this instrument is to all appearance slender and feeble, yet it is found to be a weapon of great force and efficacy. There is scarcely any substance which it will not pierce, and indeed it is seldom seen but employed in penetration. This is the weapon of defence; this is employed in destroying its prey; and, still more, by this the animal deposits her eggs wherever she thinks fit to lay them. As it is an instrument chiefly employed for this purpose, the male is unprovided with such a sting, while the female uses it with great force and dexterity, brandishing it when caught from side to side, and very often wounding those who thought they held her with the greatest security.

All the flies of this tribe are produced in the same manner, and owe their birth to the destruction of some other insect, within whose body they have been deposited, and upon whose vitals they have preyed, till they came to maturity. There is no insect whatever which they will not attack, in order to leave their fatal present in its body; the caterpillar, the gnat, and even the spider himself, so formidable to others, is often made the unwilling fosterer of this destructive progeny.

About the middle of summer, when other insects are found in great abundance, the ichneumon is seen flying busily about, and seeking proper objects upon whom to deposit its progeny. As there are various kinds of this fly, so they seem to have various appetites. Some are found to place their eggs within the aurelia of some nascent insect, others place them within the nest which the wasp had curiously contrived for its own young; and as both are produced at the same time, the young of the ichneumon not only devours the young wasp, but the whole supply of worms which the parent had carefully provided for its provision. But the greatest number of the ichneumon tribe are seen settling upon the back of the caterpillar, and darting, at different intervals, their stings into its body. At every dart they deposit an egg, while the wounded animal seems scarcely sensible of the injury it sustains. In this manner they leave from six to a dozen of their eggs within the fatty substance of the reptile's body, and then fly off to commit further depredations. In the mean time the caterpillar, thus irreparably injured, seems to feed as voraciously as before, does not abate of its usual activity, and, to all appearance, seems no way affected by the internal enemies that are preparing its destruction in their darksome abode. But they soon burst from their egg state, and begin to prey upon the substance of their prison. As they grow larger, they require a greater supply, till at last the animal by whose vitals they are supported, is no longer able to sustain them, but dies, its whole inside being almost eaten away. It often happens, however, that it survives their worm state, and then they change into a chrysalis enclosed in the caterpillar's body till the time of their delivery approaches, when they burst their prisons, and fly away. The caterpillar, however, is irreparably destroyed; it never changes into a chrysalis, but dies shortly after, from the injuries it had sustained.

Such is the history of this fly, which, though very terrible to the insect tribe, fails not to be of infinite service to mankind. The millions which it kills in a single summer are inconceivable; and without such a destroyer the fruits of the earth would only rise to furnish a banquet for the insect race, to the exclusion of all the nobler ranks of animated nature.

CHAPTER V.

OF THE ANT.

THOUGH the number of two-winged flies be very great, and the naturalists have taken some pains to describe their characters and varieties, yet there is such a similitude in their forms and manners, that in a work like this, one description must serve for all. We now, therefore, come to a species of four-winged insects, that are famous from all antiquity for their social and industrious habits, that are marked for their spirit of subordination, that are offered as a pattern of parsimony to the profuse, and of unremitting diligence to the sluggard.

In the experiments, however, which have been more recently made, and the observations which have been taken, much of their boasted frugality and precaution seems denied them: the treasures they lay up are no longer supposed intended for future provision, and the choice they make in their stores seems no way dictated by wisdom. It is indeed somewhat surprising, that almost every writer of antiquity should describe this insect as labouring in the summer, and feasting upon the produce during the winter. Perhaps in some of the warmer climates, where the winter is mild, and of short continuance, this may take place, but in France and England these animals can have no manner of occasion for a supply of winter provisions, as they are actually in a state of torpidity during that season.

The Common Ants of Europe are of two or three different kinds; some red, some black, some with stings, and others without. Such as have stings inflict their wounds in that manner; such as are unprovided with these weapons of defence, have a power of spurting from their hinder parts an acid pungent liquor, which, if it lights upon the skin, inflames and burns it like nettles.

The body of an ant is divided into the head, breast, and belly. In the head the eyes are placed, which are entirely black, and under the eyes there are two small horns or feelers, composed of twelve joints, all covered with a fine silky hair. The mouth is furnished with two crooked jaws, which project outwards, in each of which are seen incisures, that look like teeth. The breast is covered with a fine silky hair, from which project six legs that are pretty strong and hairy, the extremities of each armed with two small claws, which the animal uses in climbing. The belly is more reddish than the rest of the body, which is of a brown chesnut colour, shining as glass, and covered with extremely fine hair.

From such a formation, this animal seems bolder and more active from its size, than any other of the insect tribe, and fears not to attack a creature often above ten times its own magnitude.

As soon as the winter is past, in the first fine day in April, the ant-hill, that before seemed a desert, now swarms with new life, and myriads of these insects are seen just awaked from their annual lethargy, and preparing for the pleasures and fatigues of the season. For the first day they never offer to leave the hill, which may be considered as their citadel, but run over every part of it, as if to examine its present situation, to observe what injuries it has sustained during the rigours of winter,* while they slept, and to meditate and settle the labours of the day ensuing.

At the first display of their forces, none but the wingless tribe appears, while those furnished with wings remain at the bottom. These are the working ants that first appear, and that are always destitute of wings; the males and females, that are furnished with four large wings each, are more slow in making their appearance.

Thus, like bees, they are divided into males, females, and the neutral or the working tribe. These are easily distinguished from each other; the females are much larger than the males, the working ants are the smallest of all. The two former have wings, which, however, they sometimes are divested of; the latter never have any, and upon them are devolved all the labours that tend to the welfare of the community. The female also may be distinguished by the colour and structure of her breast, which is a little more brown than that of the common ant, and a little brighter than that of the male.

In eight or ten days after their first appearance, the labours of the hill are in some forwardness; the males and females are seen mixed with the working multitude, and pursued or pursuing each other. They seem no way to partake in the common drudgeries of the state; the males pursue the females with great assiduity, and in a manner force them to compliance. They remain coupled for some time, while the males thus united suffer themselves to be drawn along by the will of their partners.

In the mean time, the working body of the state take no part in their pleasures; they are seen diligently going from the ant-hill, in pursuit of food for themselves and their associates, and of proper materials for giving a comfortable retreat to their young, or safety to their habitation. In the fields of England, ant-hills are formed with but little apparent regularity. In the more southern provinces of Europe, they are constructed with wonderful contrivance, and offer a sight highly worthy a naturalist's curiosity. These are generally formed in the neighbourhood of some large tree and a stream of water. The one is considered by the animals as the proper place for getting food; the other, for supplying them with moisture, which they cannot well dispense with. The shape of the ant-hill is that of a sugar-loaf, about three feet high, composed of various substances, leaves, bits of wood, sand, earth, bits of gum, and grains of corn. These are all united into a compact body, per-

* Mémoires pour servir à l'Histoire des Insectes, par Charles de Geer.

forated with galleries down to the bottom, and winding ways within the body of the structure. From this retreat to the water, as well as to the tree, in different directions, there are many paths worn by constant assiduity, and along these the busy insects are seen passing and repassing continually: so that from May, or the beginning of June, according to the state of the season, they work continually till the bad weather comes on.

The chief employment of the working ants, is in sustaining not only the idlers at home, but also finding a sufficiency of food for themselves. They live upon various provisions, as well of the vegetable as the animal kind. Small insects they will kill and devour; sweets of all kinds they are particularly fond of. They seldom, however, think of their community, till they themselves are first satiated. Having found a juicy fruit, they swallow what they can, and then, tearing it in pieces, carry home their load. If they meet with an insect above their match, several of them will fall upon it at once, and having mangled it, each will carry off a part of the spoil. If they meet in their excursions any thing that is too heavy for one to bear, and yet which they are unable to divide, several of them will endeavour to force it along, some dragging and others pushing. If any one of them happens to make a lucky discovery, it will immediately give advice to others, and then at once the whole republic will put themselves in motion. If in those struggles one of them happen to be killed, some kind survivor will carry him off to a great distance, to prevent the obstructions his body may give to the general spirit of industry.

But while they are thus employed in supporting the state, in feeding abroad, and carrying in provisions to those that continue at home, they are not unmindful of posterity. After a few days of fine weather, the female ants begin to lay their eggs, and those are as assiduously watched and protected by the working ants, who take upon themselves to supply whatever is wanting to the nascent animal's convenience or necessity. They are carried, as soon as laid, to the safest situation, at the bottom of their hill, where they are carefully defended from cold and moisture. We are not to suppose, that those white substances which we so plentifully find in every ant-hill, are the eggs as newly laid. On the contrary, the ant's egg is so very small, that, though laid upon a black ground, it can scarcely be discerned. The little white bodies we see are the young animals in their maggot state, endued with life, long since freed from the egg, and often involved in a cone, which it has spun round itself, like the silk-worm. The real egg, when laid, if viewed through a microscope, appears smooth, polished, and shining, while the maggot is seen composed of twelve rings, and is often larger than the ant itself.

It is impossible to express the fond attachment which the working ants show to their rising progeny. In cold weather they take them in their mouths, but without offering them the smallest injury, to the very depths of their habitation, where they are less

subject to the severity of the season. In a fine day they remove them with the same care nearer the surface, where their maturity may be assisted by the warm beams of the sun. If a formidable enemy should come to batter down their whole habitation, and crush them by thousands in the ruin, yet these wonderful insects, still mindful of their parental duties, make it their first care to save their offspring. They are seen running wildly about, and different ways, each loaded with a young one, often bigger than the insect that supports it. "I have kept," says Swammerdam, "several of the working ants in my closet with their young, in a glass filled with earth. I took pleasure in observing, that in proportion as the earth dried on the surface, they dug deeper and deeper to deposit their eggs; and when I poured water thereon, it was surprising to see with what care, affection, and diligence, they laboured to put their brood in safety in the driest place. I have seen also, that when water has been wanting for several days, and when the earth was moistened after it a little, they immediately carried their young ones to have a share, who seemed to enjoy and suck the moisture."

When the young maggot comes to its full growth, the breast swells insensibly, it casts its skin, and loses all motion. All the members which were hidden before, then begin to appear; an aurelia is formed, which represents very distinctly all the parts of the animal, though they are yet without motion, and as it were wrapped up in swaddling clothes. When at length the little insect has passed through all its changes, and acquired its proper maturity, it bursts this last skin, to assume the form it is to retain ever after. Yet this is not done by the efforts of the little animal alone, for the old ones very assiduously break open, with their teeth, the covering in which it is enclosed. Without this assistance, the aurelia would never be able to get free, as M. de Geer often found, who tried the experiment by leaving the aurelias to themselves. The old ones not only assist them, but know the very precise time for lending their assistance; for if produced too soon, the young ones dies of cold; if retarded too long, it is suffocated in its prison.

When the female has done laying, and the whole brood is thus produced, her labours, as well as that of the male, become unnecessary, and her wings, which she had but a short time before so actively employed, drop off. What becomes of her when thus divested of her ornaments, is not well known, for she is seen in the cells for some weeks after. The males, on the other hand, having no longer any occupation at home, make use of those wings with which they have been furnished by nature, and fly away never to return, or to be heard of more. It is probable they perish with the cold, or are devoured by the birds, which are particularly fond of this petty prey.

In the mean time, the working ants having probably deposed their queens, and being deserted by the males, that served but to clog the community, prepare for the severity of the winter, and bury their retreats as deep in the earth as they conveniently can. It is now found that the grains of corn, and other substances with which

they furnish their hill, are only meant as fences to keep off the rigours of the weather, not as provisions to support them during its continuance. It is found generally to obtain, that every insect that lives a year after it is come to its full growth, is obliged to pass four or five months without taking any nourishment, and will seem to be dead all that time. It would be to no purpose, therefore, for ants to lay up corn for the winter, since they lie that time without motion, heaped upon each other, and are so far from eating, that they are utterly unable to stir. Thus what authors have dignified by the name of a magazine, appears to be no more than a cavity, which serves for a common retreat when the weather forces them to return to their lethargic state.

What has been said with exaggeration of the European ant, is however, true, if asserted of those of the tropical climates. They build an ant-hill with great contrivance and regularity, they lay up provisions, and, as they probably live the whole year, they submit themselves to regulations entirely unknown among the ants of Europe.

Those of Africa are of three kinds, the red, the green, and the black; the latter are above an inch long, and in every respect a most formidable insect. Their sting produces extreme pain, and their depredations are sometimes extremely destructive. They build an ant-hill of a very great size, from six to twelve feet high; it is made of viscous clay, and tapers into a pyramidal form. This habitation is constructed with great artifice; and the cells are so numerous and even, that a honey-comb scarce exceeds them in number and regularity.

The inhabitants of this edifice seem to be under a very strict regulation. At the slightest warning they will sally forth upon whatever disturbs them; and if they have time to arrest their enemy, he is sure to find no mercy. Sheep, hens, and even rats, are often destroyed by these merciless insects, and their flesh devoured to the bone. No anatomist in the world can strip a skeleton so cleanly as they; and no animal, how strong soever, when they have once seized upon it, has power to resist them.

It often happens that these insects quit their retreat in a body, and go in quest of adventures. "During my stay," says Smith, "at Cape Corse Castle, a body of these ants came to pay us a visit in our fortification. It was about day-break when the advanced guard of this famished crew entered the chapel, where some Negro servants were asleep upon the floor. The men were quickly alarmed at the invasion of this unexpected army, and prepared, as well as they could, for a defence. While the foremost battalion of insects had already taken possession of the place, the rear-guard was more than a quarter of a mile distant. The whole ground seemed alive, and crawling with unceasing destruction. After deliberating a few moments upon what was to be done, it was resolved to lay a large train of gunpowder along the path they had taken; by this means millions were blown to pieces, and the rear-

guard perceiving the destruction of their leaders, thought proper instantly to return, and make back to their original habitation."

The order which these ants observe seems very extraordinary; whenever they sally forth, fifty or sixty larger than the rest are seen to head the band, and conduct them to their destined prey. If they have a fixed spot where their prey continues to resort, they then form a vaulted gallery, which is sometimes a quarter of a mile in length, and yet they will hollow it out in the space of ten or twelve hours.

[The Philosophical Transactions for 1781 contain a very curious and interesting description of the White Ant, written by Mr. Smeathman of Clement's Inn. According to this account, the works of these insects surpass those of the bees, wasps, beavers, and other animals, as much at least as those of the most polished European nations excel those of the least cultivated savages. And even with regard to man, his greatest works, the boasted pyramids, fall comparatively far short, even in size alone, of the structures raised by these insects. The labourers among them employed in this service are not a quarter of an inch in length; but the structures which they erect rise to twelve feet and upwards above the surface of the earth. The interior construction, and the various members and dispositions of the parts of the building, appear greatly to exceed any work of human architecture.

There are three distinct ranks or orders among them, constituting a well regulated community. These are, first, the labourers, or working insects; next the soldiers, or fighting order, who do no kind of labour, and are about twice as long as the former, and equal in bulk to about fifteen of them; and lastly, the winged or perfect insects, which may be called the nobility of the state, for they neither labour nor fight, being scarcely capable even of self-defence. "These only are capable of being elected kings or queens; and nature has so ordered it, that they emigrate within a few weeks after they are elevated to this state, and either establish new kingdoms, or perish within a day or two."

The first order, the working insects, are most numerous, being in the proportion of one hundred to one of the soldiers. In this state they are about a quarter of an inch long, and twenty-five of them weigh about a grain, so that they are not so large as some of our ants.

The second order, or soldiers, have a very different form from the labourers, and have been by some authors supposed to be the males, and the former neuters; but they are, in fact, the same insects as the foregoing, only they have undergone a change of form, and approached one degree nearer to the perfect state. They are now much larger, being half an inch long, and equal in bulk to fifteen of the labourers.

The third order, or the insect in its perfect state, varies its form still more than ever. The head, thorax, and abdomen, differ almost entirely from the same parts in the labourers and soldiers; and, besides this, the animal is now furnished with four fine large

brownish transparent wings, with which it is at the time of emigration to wing its way in search of a new settlement. It differs so much from the other two, that they have not hitherto been supposed to belong to the same community. In fact, they are not to be discovered in the nest till the approach of the rainy season, when they undergo the last change, which is preparative to the formation of new colonies. They are equal in bulk to two soldiers and about thirty labourers; and by means of the wings with which they are furnished, they roam about for a few hours, at the end of which time they lose their wings, and become the prey of innumerable birds, reptiles and insects, while probably not a pair out of many million get into a place of safety, and lay the foundation of a new community. In this state many fall into neighbouring waters, and are eaten with avidity by the Africans.

The few fortunate pairs who happen to survive this annual massacre and destruction, are represented as being casually found by some of the labourers that are continually running about on the surface of the ground, and then elected kings and queens of new states. By these industrious creatures the king and queen elect are immediately protected from their innumerable enemies, by being enclosed in a chamber of clay. Their "voluntary subjects" then busy themselves in constructing wooden nurseries, or apartments entirely composed of wooden materials, seemingly joined together with gums. Into these they afterwards carry the eggs produced from the queen, lodging them there as fast as they can obtain them from her.

After impregnation, a very extraordinary change begins to take place in her person, or rather in her abdomen only. It gradually increases in bulk, and at length becomes of such an enormous size as to exceed the rest of her body nearly two thousand times.

The eggs, which to the number of eight thousand are protruded within twenty-four hours, "are instantly taken from her body by her attendants (of whom there always are, in the royal chamber and the galleries adjacent, a sufficient number in waiting), and carried to the nurseries, which are sometimes four or five feet distant in a straight line. Here, after they are hatched, the young are attended and provided with every thing necessary, until they are able to shift for themselves, and take their share of the labours of the community."

Many curious and striking particulars are related of the great devastations committed by this powerful community, which construct roads, or rather covered ways, diverging in all directions from the nest, and leading to every object of plunder within their reach.]

CHAPTER VI.

OF THE BEETLE, AND ITS VARIETIES.

HITHERTO we have been treating of insects with four transparent wings, we now come to a tribe with two transparent wings, with cases that cover them close while at rest, but which allow them their proper play when flying. The principal of these are the Beetle, the May-Bug, and the Cantharis. These are all bred, like the rest of their order, first from eggs, then they become grubs, then a chrysalis in which the future fly is distinctly seen, and lastly the animal leaves its prison, breaking forth as a winged animal in full maturity.

Of the Beetle there are various kinds; all, however, concurring in one common formation of having cases to their wings, which are the more necessary to those insects, as they often live under the surface of the earth, in holes which they dig out by their own industry. These cases prevent the various injuries their real wings might sustain, by rubbing or crushing against the sides of their abode. These, though they do not assist flight, yet keep the internal wings clean and even, and produce a loud buzzing noise when the animal rises in the air.

If we examine the formation of all animals of the beetle kind, we shall find, as in shell-fish, that their bones are placed externally, and their muscles within. These muscles are formed very much like those of quadrupeds, and are endued with such surprising strength, that, bulk for bulk, they are a thousand times stronger than those of a man. The strength of these muscles is of use in digging the animal's subterraneous abode, where it is most usually hatched, and to which it most frequently returns, even after it becomes a winged insect, capable of flying.

Beside the difference which results from the shape and colour of these animals, the size also makes a considerable one; some beetles being not larger than the head of a pin, while others, such as the elephant beetle, are as big as one's fist. But the greatest difference among them is, that some are produced in a month, and in a single season go through all the stages of their existence, while others take near four years to their production, and live as winged insects a year more. To give the history of all these animals, that are bred pretty much in the same way, would be insipid and endless; it will suffice to select one or two from the number, the origin of which may serve as specimens of the rest. I will therefore offer the history of the May-bug to the reader's attention, premising, that most other beetles, though not so long-lived, are bred in the same manner.

The May-bug or Dorr-beetle, as some call it, has, like all the rest, a pair of cases to its wings, which are of a reddish-brown colour, sprinkled with a whitish dust, which easily comes off. In

some years their necks are seen covered with a red plate, and in others with a black; these, however, are distinct sorts, and their difference is by no means accidental. The fore-legs are very short, and the better calculated for burrowing in the ground, where this insect makes its retreat. It is well known for its evening buzz to children, but still more formidably introduced to the acquaintance of husbandmen and gardeners; for in some seasons it has been found to swarm in such numbers, as to eat up every vegetable production.

The two sexes in the May-bug, are easily distinguished from each other, by the superior length of the tufts at the end of the horns in the male. They begin to copulate in summer, and at that season they are seen joined together for a considerable time. The female being impregnated, quickly falls to boring a hole in the ground, where to deposit her burden. This is generally about half a foot deep, and in it she places her eggs, which are of an oblong shape, with great regularity, one by the other. They are of a bright yellow colour, and no way wrapped up in a common covering, as some have imagined. When the female is lightened of her burden, she again ascends from her hole, to live as before, upon leaves and vegetables, to buzz in the summer evening, and to lie hid among the branches of trees in the heat of the day.

In about three months after these eggs have been thus deposited in the earth, the contained insect begins to break its shell, and a small grub or maggot crawls forth, and feeds upon the roots of whatever vegetable it happens to be nearest. All substances of this kind seem equally grateful; yet it is probable the mother insect has a choice among what kind of vegetables she shall deposit her young. In this manner these voracious creatures continue in the worm state, for more than three years, devouring the roots of every plant they approach, and making their way under ground, in quest of food, with great dispatch and facility. At length they grow to about the size of a walnut, being a great thick white maggot with a red head, which is seen most frequently in new-turned earth, and which is so eagerly sought after by birds of every species. When largest, they are found an inch and a half long, of a whitish-yellow colour, with a body consisting of twelve segments or joints, on each side of which there are nine breathing holes, and three red feet. The head is large in proportion to the body, of a reddish colour, with a pincer before, and a semi-circular lip, with which it cuts the roots of plants and sucks out their moisture. As this insect lives entirely under ground, it has no occasion for eyes, and accordingly it is found to have none; but is furnished with two feelers, which, like the crutch of a blind man, serves to direct its motions. Such is the form of this animal, that lives for years in the worm state under ground, still voracious, and every year changing its skin.

It is not till the end of the fourth year that this extraordinary insect prepares to emerge from its subterraneous abode, and even

this is not effected but by a tedious preparation. About the latter end of autumn, the grub begins to perceive the approach of its transformation; it then buries itself deeper and deeper in the earth, sometimes six feet beneath the surface, and there forms itself a capacious apartment, the walls of which it renders very smooth and shining, by the excretions of its body. Its abode being thus formed, it begins soon after to shorten itself, to swell, and to burst its last skin, in order to assume the form of a chrysalis. This, in the beginning, appears of a yellowish colour, which heightens by degrees, till at last it is seen nearly red. Its exterior form plainly discovers all the vestiges of the future winged insect, all the fore parts being distinctly seen, while behind the animal seems as if wrapped in swaddling clothes.

The young May-bug continues in this state for about three months longer, and it is not till the beginning of January that the aurelia divests itself of all its impediments, and becomes a winged insect, completely formed. Yet still the animal is far from attaining its natural strength, health, and appetite. It undergoes a kind of infant imbecility; and, unlike most other insects, that the instant they become flies are arrived at their state of full perfection, the May-bug continues feeble and sickly. Its colour is much brighter than in the perfect animal; all its parts are soft, and its voracious nature seems for a while to have entirely forsaken it. As the animal is very often found in this state, it is supposed, by those unacquainted with its real history, that the old ones, of the former season, have buried themselves for the winter, in order to revisit the sun the ensuing summer. But the fact is, the old one never survives the season, but dies, like all the other winged tribe of insects, from the severity of cold in winter.

About the latter end of May, these insects, after having lived for four years under ground, burst from the earth, when the first mild evening invites them abroad. They are at that time seen rising from their long imprisonment, from living only upon roots, and imbibing only the moisture of the earth, to visit the mildness of the summer air, to choose the sweetest vegetables for their banquet, and to drink the dew of the evening. Wherever an attentive observer then walks abroad, he will see them bursting up before him in his pathway, like ghosts on a theatre. He will see every part of the earth, that had its surface beaten into hardness, perforated by their egression. When the season is favourable for them, they are seen by myriads buzzing along, hitting against every object that intercepts their flight. The mid-day sun, however, seems too powerful for their constitutions; they then lurk under the leaves and branches of some shady tree, but the willow seems particularly their most favourite food; there they lurk in clusters, and seldom quit the tree till they have devoured all its verdure. In those seasons which are favourable to their propagation, they are seen in an evening as thick as flakes of snow, and hitting against every object with a sort of capricious blindness. Their duration,

however, is but short, as they never survive the season. They begin to join shortly after they have been let loose from their prison; and when the female is impregnated, she cautiously bores a hole in the ground with an instrument fitted for that purpose which she is furnished with at the tail, and there deposits her eggs, generally to the number of threescore. If the season and the soil be adapted to their propagation, these soon multiply as already described, and go through the noxious stages of their contemptible existence. This insect, however, in its worm state, though prejudicial to man, makes one of the chief repasts of the feathered tribe, and is generally the first nourishment with which they supply their young. Rooks and hogs are particularly fond of these worms, and devour them in great numbers. The inhabitants of the county of Norfolk some time since went into the practice of destroying their rookeries; but in proportion as they destroyed one plague, they were pestered with a greater, and these insects multiplied in such an amazing abundance, as to destroy not only the verdure of the fields, but even the roots of vegetables not yet shot forth. One farm in particular was so injured by them in the year 1751, that the occupier was not able to pay his rent; and the landlord was not only content to lose his income for that year, but also gave money for the support of the farmer and his family. In Ireland they suffered so much by these insects, that they came to a resolution of setting fire to a wood of some miles in extent, to prevent their mischievous propagation.

Of all the beetle kind, this is the most numerous, and therefore deserves the chief attention of history. The numerous varieties of other kinds might repay the curiosity of the diligent observer, but we must be content in general to observe, that in the great outlines of their history they resemble those of which we have just been giving a description: Like them, all other beetles are bred from the egg, which is deposited in the ground, or sometimes, though seldom, in the barks of trees; they change into a worm; they subsist in that state by living upon the roots of vegetables, or the succulent parts of the bark round them. They generally live a year at least before they change into an aurelia; in that state they are not entirely motionless, nor entirely swaddled up without form.

It would be tedious and endless to give a description of all, and yet it would be an unpardonable omission not to mention the particularities of some beetles, which are singular either from their size, their manners, or their formation. That beetle which the Americans call the tumble-dung, particularly demands our attention; it is all over of a dusky black, rounder than those animals are generally found to be, and so strong, though not much larger than the common black beetle, that if one of them be put under a brass candlestick, it will cause it to move backwards and forwards as if it were by an invisible hand, to the admiration of those who are not accustomed to the sight. But this strength is given it for much

more useful purposes than those of exciting human curiosity, for there is no creature more laborious either in seeking subsistence, or in providing a proper retreat for its young. They are endowed with sagacity to discover subsistence by their excellent smelling, which directs them in flights to excrements just fallen from man or beasts, on which they instantly drop, and fall unanimously to work in forming round balls or pellets thereof, in the middle of which they lay an egg. These pellets in September they convey three feet deep in the earth, where they lie till the approach of spring, when the eggs are hatched, the nests burst, and the insects find their way out of the earth. They assist each other with indefatigable industry in rolling these globular pellets to the place where they are to be buried. This they are to perform with the tail foremost, by raising up their hinder part, and shoving along the ball with their hind feet. They are always accompanied with other beetles of a larger size, and of a more elegant structure and colour. The breast of this is covered with a shield of a crimson colour, and shining like metal; the head is of the like colour, mixed with green, and on the crown of the head stands a shining black horn, bended backwards. These are called the kings of the beetles, but for what reason is uncertain, since they partake of the same dirty drudgery with the rest.

The Elephant Beetle is the largest of this kind hitherto known, and is found in South America, particularly Guiana and Surinam, as well as about the river Oroonoko. It is of a blacker colour, and the whole body is covered with a very hard shell, full as thick and as strong as that of a small crab. Its length, from the hinder part to the eyes, is almost four inches, and from the same part to the end of the proboscis, or trunk, four inches and three quarters. The transverse diameter of the body is two inches and a quarter, and the breadth of each elytron, or case for the wings, is an inch and three-tenths. The antennæ, or feelers, are quite horny; for which reason the proboscis, or trunk, is moveable at its insertion into the head, and seems to supply the place of feelers. The horns are eight-tenths of an inch long, and terminate in points. The proboscis is an inch and a quarter long, and turns upwards, making a crooked line, terminating in two horns, each of which is near a quarter of an inch long; but they are not perforated at the end like the proboscis of other insects. About four-tenths of an inch above the head, on that side next the body, is a prominence, or small horn, which, if the rest of the trunk were away, would cause this part to resemble the horn of a rhinoceros. There is indeed a beetle so called, but then the horn, or trunk, has no fork at the end, though the lower horn resembles this. The feet are all forked at one end, but not like lobsters' claws.

To this class we may also refer the Glow-worm, that little animal which makes such a distinguished figure in the descriptions of our poets. No two insects can differ more than the male and female of this species from each other. The male is in every respect a beetle,

having cases to its wings, and rising in the air at pleasure; the female, on the contrary, has none, but is entirely a creeping insect, and is obliged to wait the approaches of her capricious companion. The body of the female has eleven joints, with a shield breast-plate, the shape of which is oval; the head is placed over this, and is very small; and the three last joints of her body are of a yellowish colour: but what distinguishes it from all other animals, at least in this part of the world, is the shining light which it emits by night, and which is supposed by some philosophers to be an emanation which she sends forth to allure the male to her company. Most travellers who have gone through sandy countries must well remember the little shining sparks with which the ditches are studded on each side of the road. If incited by curiosity to approach more nearly, he will find this light sent forth by the glow-worm; if he should keep the little animal for some time, its light continues to grow paler, and at last appears totally extinct. The manner in which the light is produced has hitherto continued inexplicable: it is probable the little animal is supplied with some electrical powers, so that by rubbing the joints of its body against each other, it thus supplies a stream of light, which, if it allures the male, as we are told, serves for very useful purposes.

The Cantharis is of the beetle kind, from whence came cantharides, well known in the shops by the name of Spanish flies, and for their use in blisters. They have feelers like bristles, flexible cases to the wings, a breast pretty plain, and the sides of the belly wrinkled. Cantharides differ from each other in their size, shape, and colour; those used in the shops also do the same. The largest in these parts are about an inch long, and as much in circumference, but others are not above three quarters of an inch. Some are of a pure azure colour, others of pure gold, and others again have a mixture of pure gold and azure colours; but they are all very brilliant and extremely beautiful. These insects, as is well known, are of the greatest benefit to mankind, making a part in many medicines conducive to human preservation. They are chiefly natives of Spain, Italy, and Portugal; but they are to be met with also about Paris in the summer time, upon the leaves of the ash, the poplar, and the rose trees, and also among wheat, and in meadows. It is very certain that these insects are fond of ash leaves, insomuch that they will sometimes strip one of these trees quite bare. Some affirm, that these flies delight in sweet smelling herbs; and it is very certain that they are fond of honey-suckles, lilac, and wild-cherry shrubs; but some that have sought after them declare, they never could find them on elder trees, nut trees, and among wheat. We are told that the country people expect the return of these insects every seven years. It is very certain that such a number of these insects have been seen together in the air, that they appeared like swarms of bees: and that they have so disagreeable a smell, that it may be perceived a great way off, especially about sun-set, though they are not seen at that time. This bad smell is a guide for those who make it their

business to catch them. When they are caught, they dry them, after which they are so light, that fifty will hardly weigh a drachm. Those that gather them, tie them in a bag, or a piece of linen cloth that has been well worn, and then they kill them with the vapours of hot vinegar, after which they dry them in the sun, and keep them in boxes. These flies, thus dried, being chemically analyzed, yield a great deal of volatile caustic salt, mixed with a little oil, phlegm, and earth. Cantharides are penetrating, corrosive, and, applied to the skin, raise blisters, from whence proceeds a great deal of serosity. They are made use of both inwardly and outwardly. However, it is somewhat strange that the effect of these flies should fall principally upon the urinary passages; for though some authors have endeavoured to account for this, we are still in the dark, for all they have said amounts to no more, than that they affect these parts in a manner which may be very learnedly described, but very obscurely comprehended.

An insect of great, though perhaps not equal use in medicine, is that which is known by the name of the Kermes. It is produced in the excrescence of an oak, called the berry-bearing ilex, and appears at first wrapt up in a membranaceous bladder of the size of a pea, smooth and shining, of a brownish-red colour, and covered with a fine ash-coloured powder. This bag teems with a number of reddish eggs or insects, which being rubbed with the fingers pour out a crimson liquor. It is only met with in warm countries in the months of May and June. In the month of April this insect becomes of the size and shape of a pea, and its eggs some time after burst from the womb, and soon turning worms, run about the branches and leaves of the tree. They are of two sexes, and the females have been hitherto described; but the males are very distinct from the former, and are a sort of small flies like gnats, with six feet, of which the four forward are short, and the two backward long, divided into four joints, and armed with three crooked nails. There are two feelers on the head a line and a half long, which are moveable, streaked, and articulated. The tail, at the back part of the body, is half a line long, and forked. The whole body is covered with two transparent wings, and they leap about in the manner of fleas. The harvest of the kermes is greater or less in proportion to the severity of the winter; and the women gather them before sun-rising, tearing them off with their nails, for fear there should be any loss from the hatching of the insects. They sprinkle them with vinegar, and lay them in the sun to dry, where they acquire a red colour.

An insect perhaps still more useful than either of the former is the Cochineal, which has been variously described by authors. Some have supposed it a vegetable excrescence from the tree upon which it is found; some have described it as a louse, some as a bug, and some as a beetle. As they appear in our shops when brought from America, they are of an irregular shape, convex on one side, and a little concave on the other; but both are marked with transverse

streaks or wrinkles. They are of a scarlet colour within, and without of a blackish red, and sometimes of a white, reddish, or ash colour, which are accounted the best, and are brought to us from Mexico. The cochineal insect is of an oval form, of the size of a small pea, with six feet, and a snout or trunk. It brings forth its young alive, and is nourished by sucking the juice of the plant. Its body consists of several rings, and when it is once fixed on the plant it continues immoveable, being subject to no change. Some pretend there are two sorts, the one domestic, which is best, and the other wild, that is of a vivid colour; however, they appear to be the same, only with this difference, that the wild feeds upon uncultivated trees, without any assistance, whereas the domestic is carefully, at a stated season, removed to cultivated trees, where it feeds upon a purer juice. Those who take care of these insects place them on the prickly pear-plant in a certain order, and are very industrious in defending them from other insects, for if any other kind come among them, they take care to brush them off with foxes tails. Towards the end of the year, when the rains and cold weather are coming on, which are fatal to these insects, they take off the leaves or branches covered with cochineal, that have not attained their utmost degree of perfection, and keep them in their houses till winter is past. These leaves are very thick and juicy, and supply them with sufficient nourishment while they remain within doors. When the milder weather returns, and these animals are about to exclude their young, the natives make them nests, like those of birds, but less, of tree-moss, or soft hay, or the down of cocoa nuts, placing twelve in every nest. These they fix on the thorns of the prickly pear-plant, and in three or four days' time they bring forth their young, which leave their nests in a few days, and creep upon the branches of the plant, till they find a proper place to rest on, and take in their nourishment, and until the females are fecundated by the males, which, as in the former tribe, differ very widely from the females, being winged insects, whereas the others only creep, and are at most stationary. When they are impregnated they produce a new offspring, so that the propagator has a new harvest thrice a-year. When the native Americans have gathered the cochineal, they put them into holes in the ground, where they kill them with boiling water, and afterwards dry them in the sun, or in an oven, or lay them upon hot plates. From the various methods of killing them, arise the different colours which they appear in when brought to us. While they are living, they seem to be sprinkled over with a white powder, which they lose as soon as the boiling water is poured upon them. Those that are dried upon hot plates are the blackest. What we call the cochineal are only the females, for the males are a sort of fly, as already observed in the kermes. They are used both for dyeing and medicine, and are said to have much the same virtue as the kermes,

though they are now seldom used alone, but are mixed with other things for the sake of the colour.

I shall end this account of the beetle tribe, with the history of an animal which cannot properly be ranked under this species, and yet which cannot be more methodically ranged under any other. This is the insect that forms and resides in the gall-nut, the spoils of which are converted to such nseful purposes. The Gall Insects are bred in a sort of bodies adhering to a kind of oak in Asia, which differ with regard to their colour, size, roughness, smoothness, and shape, and which we call galls. They are not fruit, as some have imagined, but preternatural tumours, owing to the wounds given to the buds, leaves, and twigs of the tree, by a kind of insects that lay their eggs within them. This animal is furnished with an implement, by which the female penetrates into the bark of the tree, or into that spot which just begins to bud, and there sheds a drop of corrosive fluid into the cavity. Having thus formed a receptacle for her eggs, she deposits them in the place, and dies soon after. The heart of the bud being thus wounded, the circulation of the nutritive juice is interrupted, and the fermentation thereof, with the poison injected by the fly, burns the parts adjacent, and then alters the natural colour of the plant. The juice or sap, turned back from its natural course, extravasates and flows round the egg; after which it swells and dilates by the assistance of some bubbles of air, which get admission through the pores of the back, and which run in the vessels with the sap. The external coat of this excrescence is dried by the air, and grows into a figure which bears some resemblance to the bow of an arch, or the roundness of a kernel. This little ball receives its nutriment, growth, and vegetation, as the other parts of the tree, by slow degrees, and is what we call the gall-nut. The worm that is hatched under this spacious vault, finds in the substance of the ball, which is as yet very tender, a subsistence suitable to its nature; gnaws and digests it till the time comes for its transformation to a nymph, and from that state of existence changes into a fly. After this, the insect, perceiving itself duly provided with all things requisite, disengages itself soon from its confinement, and takes its flight into the open air. The case, however, is not similar with respect the gall-nut that grows in autumn. The cold weather frequently comes on before the worm is transformed into a fly, or before the fly can pierce through its enclosure. The nut falls with the leaves, and although you may imagine that the fly which lies within is lost, yet in reality it is not so; on the contrary, its being covered up so close, is the means of its preservation. Thus it spends the winter in a warm house, where every crack and cranny of the nut is well stopped up, and lies buried as it were under a heap of leaves, which preserves it from the injuries of the weather. This apartment, however, though so commodious a retreat in the winter, is a perfect prison in the spring. The fly, roused out of its lethargy by the first heats, breaks its way through,

and ranges where it pleases. A very small aperture is sufficient, since at this time the fly is but a diminutive creature. Besides, the ringlets whereof its body is composed, dilate, and become pliant in the passage.

BIBLIOTHECA BODLEIANA

CHAPTER VII.

OF THE GNAT AND TIPULA.

THERE are two insects which entirely resemble each other in their form, and yet widely differ in their habits, manners and propagation. Those who have seen the Tipula, or Long-legs, and the larger kind of Gnat, have most probably mistaken the one for the other; they have often accused the Tipula, a harmless insect, of depredations made by the gnat, and the innocent have suffered for the guilty. Indeed, the differences in their form are so very minute, that it often requires the assistance of a microscope to distinguish the one from the other: they are both mounted on long legs, both furnished with two wings and a slender body; their heads are large, and they seem to be hump-backed; the chief and only difference therefore is, that the tipula wants a trunk, while the gnat has a large one, which it often exerts to very mischievous purposes. The tipula is a harmless peaceful insect, that offers injury to nothing; the gnat is sanguinary and predaceous, ever seeking out for a place in which to bury its trunk, and pumping up the blood from the animal in large quantities.

The gnat proceeds from a little worm which is usually seen at the bottom of standing waters. The manner in which the insect lays its eggs is particularly curious: after having laid the proper number on the surface of the water, it surrounds them with a kind of unctuous matter, which prevents them from sinking; but at the same time fastens them with a thread to the bottom to prevent their floating away at the mercy of every breeze, from a place the warmth of which is proper for their production, to any other, where the water may be too cold, or the animal's enemies too numerous. Thus the insects, in their egg state, resemble a buoy which is fixed by an anchor. As they come to maturity they sink deeper, and at last, when they leave the egg as worms, they creep at the bottom. They now make themselves lodgments of cement, which they fasten to some solid body at the very bottom of the water, unless, by accident, they meet with a piece of chalk, which being of a soft and pliant nature, gives them an opportunity of sinking a retreat for themselves, where nothing but the claws of a cray-fish can possibly molest them. The worm afterwards changes its form. It appears with a large head, and a tail invested with

hair, and moistened with an oleaginous liquor, which she makes use of as a cork, to sustain her head in the air, and her tail in the water, and to transport her from one place to another. When the oil with which her tail is moistened begins to grow dry, she discharges out of her mouth an unctuous humour, which she sheds all over her tail, by virtue whereof she is enabled to transport herself where she pleases, without being either wet or any way incommoded by the water. The gnat in her second state is, properly speaking, in her form of a nymph, which is an introduction or entrance into a new life. In the first place, she divests herself of her second skin; in the next she resigns her eyes, her antennæ, and her tail; in short, she actually seems to expire. However, from the spoils of the amphibious animal, a little winged insect cuts the air, whose every part is active to the last degree, and whose whole structure is the just object of our admiration. Its little head is adorned with a plume of feathers, and its whole body invested with scales and hair to secure it from any wet or dust. She makes trial of the activity of her wings, by rubbing them either against her body or her broad side-bags, which keep her in an equilibrium. The furbelow, or little border of fine feathers, which graces her wings, is very curious, and strikes the eye in the most agreeable manner. There is nothing, however, of greater importance to the gnat than her trunk, and that weak implement may justly be deemed one of nature's master-pieces. It is so very small, that the extremity of it can scarcely be discerned through the best microscope that can be procured. That part which is at first obvious to the eye, is nothing but a long scaly sheath under the throat. At near the distance of two-thirds of it there is an aperture, through which the insect darts out four stings, and afterwards retracts them; one of which, however sharp and active it may be, is no more than the case in which the other three lie concealed, and run in a long groove. The sides of these stings are sharpened like two-edged swords; they are likewise barbed, and have a vast number of cutting teeth towards the point, which turns up like a hook, and is fine beyond expression. When all these darts are stuck into the flesh of animals, sometimes one after another, and sometimes all at once, the blood and humours of the adjacent parts must unavoidably be extravasated, upon which a tumour must consequently ensue, the little orifice whereof is closed up by the compression of the external air. When the gnat, by the point of her case, which she makes use of as a tongue, has tasted any fruit, flesh, or juice, that she has found out, if it be a fluid, she sucks it up without playing her darts into it; but in case she finds the least obstruction by any flesh whatever, she exerts her strength, and pierces through it, if possibly she can. After this she draws back her stings into their sheath, which she applies to the wound in order to extract, as through a reed, the juices which she finds enclosed. This is the implement with which the gnat performs her work in the summer, for during the winter she has no manner of occasion for it. Then she ceases to eat, and spends all that tedious season either in quarries

or in caverns, which she abandons at the return of summer, and flies about in search after some commodious ford, or standing water, where she may produce her progeny, which would be soon washed away and lost by the too rapid motion of any running stream. The little brood are sometimes so numerous that the very water is tinged according to the colour of the species, as green, if they be green, and of a sanguine hue, if they be red.

These are circumstances sufficiently extraordinary in the life of this little animal; but it offers something still more curious in the method of its propagation. However similar insects of the gnat kind are in their appearance, yet they differ widely from each other in the manner in which they are brought forth; for some are oviparous, and are produced from eggs; some are viviparous, and come forth in their most perfect form; some are males, and unite with the female; some are females, requiring the impregnation of the male; some are of neither sex, yet still produce young, without any copulation whatsoever. This is one of the strangest discoveries in all natural history! A gnat separated from the rest of its kind, and enclosed in a glass vessel, with air sufficient to keep it alive, shall produce young, which also, when separated from each other, shall be the parent of a numerous progeny. Thus, down for five or six generations, do these extraordinary animals propagate without the use of copulation, without any congress between the male and female, but the manner of vegetables, the young bursting from the body of their parents, without any previous impregnation. At the sixth generation, however, their propagation stops; the gnat no longer produces its like from itself alone, but it requires the access of the male to give it another succession of fecundity.

The gnat of Europe gives but little uneasiness; it is sometimes heard to hum about our beds at night, and keeps off the approach of sleep by the apprehension it causes; but it is very different in the ill-peopled regions of America, where the waters stagnate, and the climate is warm, and where they are produced in multitudes beyond expression. The whole air is there filled with clouds of those famished insects; and they are found of all sizes, from six inches long to a minuteness that even requires the microscope to have a distinct perception of them. The warmth of the mid-day sun is too powerful for their constitutions; but when the evening approaches, neither art nor flight can shield the wretched inhabitants from their attacks—though millions are destroyed, still millions more succeed, and produce unceasing torments. The native Indians, who anoint their bodies with oil, and who have from their infancy been used to their depredations, find them much less inconvenient than those who are newly arrived from Europe; they sleep in their cottages covered all over with thousands of the gnat kind upon their bodies, and yet do not seem to have their slumbers interrupted by their cruel devourers. If a candle happens to be lighted in one of those places, a cloud of insects at once light upon the flame, and extinguish it; they are therefore obliged to keep their candles in glass lanterns—a miserable expedient to prevent an unceasing calamity!

PART V.

HISTORY OF THE ZOOPHYTES.

CHAPTER I.

OF ZOOPHYTES IN GENERAL.

We now come to the last link in the chain of animated nature; to a class of beings so confined in their powers, and so defective in their formation, that some historians have been at a loss whether to consider them as a superior rank of vegetables, or the humblest order of the animated tribe. In order therefore to give them a denomination agreeable to their existence, they have been called Zoophytes, a name implying vegetable nature endued with animal life; and indeed, in some the marks of the animal are so few, that it is difficult to give their place in nature with precision, or to tell whether it is a plant or an insect that is the object of our consideration.

Should it be asked what it is that constitutes the difference between animal and vegetable life, what it is that lays the line that separates those two great kingdoms from each other, it would be difficult, perhaps we should find it impossible, to return an answer. The power of motion cannot form this distinction, since some vegetables are possessed of motion, and many animals are totally without it. The sensitive plant has obviously a greater variety of motions than the oyster or the pholas. The animal that fills the acorn-shell is immovable, and can only close its lid to defend itself from external injury, while the flower which goes by the name of the fly-trap, seems to close upon the flies that light upon it, and that attempt to rifle it of its honey. The animal in this instance seems to have scarcely a power of self-defence; the vegetable not only guards its possessions, but seizes upon the robber that would venture to invade them. In like manner, the methods of propagation give no superiority to the lower rank of animals. On the contrary, vegetables are frequently produced more conformably to the higher ranks of the creation; and though some plants are produced by cuttings from others, yet the general manner of propagation is from seeds laid in the womb of the earth, where they are hatched into the similitude of the parent plant or flower. But a most numerous tribe of animals have lately been discovered, which are propagated by cuttings, and this in so extraordinary a

manner, that, though the original insect be divided into a thousand parts, each, however small, shall be formed into an animal, entirely resembling that which was at first divided: in this respect, therefore, certain races of animals seem to fall beneath vegetables, by their more imperfect propagation.

What, therefore, is the distinction between them? or are the orders so intimately blended as that it is impossible to mark the boundaries of each? To me it would seem that all animals are possessed of one power, of which vegetables are totally deficient; I mean either the actual ability, or an awkward attempt at self-preservation. However vegetables may seem possessed of this important quality, yet it is with them but a mechanical impulse, resembling the raising one end of the lever, when you depress the other: the sensitive plant contracts and hangs its leaves, indeed, when touched, but this motion no way contributes to its safety; the fly-trap flower acts entirely in the same manner, and though it seems to seize the little animal that comes to annoy it, yet in reality, it only closes mechanically upon it, and this enclosure neither contributes to its preservation nor its defence. But it is very different with insects even of the lowest order: the earth-worm not only contracts but hides itself in the earth, and escapes with some share of swiftness from its pursuers. The polypus hides its horns; the star-fish contracts its arms upon the appearance even of distant dangers: they not only hunt for their food, but provide for their safety; and however imperfectly they may be formed, yet still they are in reality placed many degrees above the highest vegetable of the earth, and are possessed of many animal functions, as well as those that are more elaborately performed.

But though these be superior to plants, they are very far beneath their animated fellows of existence. In the class of zoophytes, we may place all those animals which may be propagated by cuttings; or in other words, which, if divided into two or more parts, each part in time becomes a separate and perfect animal; the head shoots forth a tail, and on the contrary the tail produces a head. Some of these will bear dividing but into two parts, such is the earth-worm; some may be divided into more than two, and of this kind are many of the star-fish; others still may be cut into a thousand parts, each becoming a perfect animal; they may be turned inside out, like the finger of a glove, they may be moulded into all manner of shapes, yet still their vivacious principle remains, still every single part becomes perfect in its kind, and after a few days' existence exhibits all the arts and industry of its contemptible parent! We shall therefore divide zoophytes according to their several degrees of perfection, namely, into Worms, Star-fish, and Polypi; contenting ourselves with a short review of those nauseous and despicable creatures, that excite our curiosity chiefly by their imperfections. It must not be concealed, however, that much has of late been written on this part of natural history. A new mode of animal production could not fail of exciting not only the

curiosity, but the astonishment of every philosopher: many found their favourite systems totally overthrown by the discovery; and it was not without a wordy struggle that they gave up what had formerly been their pleasure and their pride. At last, however, conviction became too strong for argument; and a question which owed its general spread rather to its novelty than to its importance, was given up in favour of the new discovery.

CHAPTER II.

OF WORMS.

The first in the class of zoophytes are animals of the Worm kind, which being entirely destitute of feet trail themselves along upon the ground, and find themselves a retreat under the earth, or in the water. As these, like serpents, have a creeping motion, so both in general, go under the common appellation of reptiles; a loathsome, noxious, malignant tribe, to which man by nature, as well as by religion, has the strongest antipathy. But though worms, as well as serpents, are mostly without feet, and have been doomed to creep along the earth on their bellies, yet their motions are very different. The serpent, as has been said before, having a back-bone which it is incapable of contracting, bends its body into the form of a bow, and then shoots forward from the tail; but it is very different with the worm, which has a power of contracting or lengthening itself at will. There is a spiral muscle that runs round its whole body, from the head to the tail, somewhat resembling a wire wound round a walking cane, which, when slipped off, and one end extended and held fast, will bring the other nearer to it; in this manner the earth-worm having shot out or extended its body, takes hold by the slime of the fore part of its body, and so contracts and brings forward the hinder part: in this manner it moves onward, not without great effort, but the occasions for its progressive motion are few.

As it is designed for living under the earth, and leading a life of obscurity, so it seems tolerably adapted to its situation. Its body is armed with small stiff sharp burrs or prickles, which it can erect or depress at pleasure; under the skin there lies a slimy juice, to be ejected as occassion requires, at certain perforations between the rings of the muscles, to lubricate its body, and facilitate its passage into the earth. Like most other insects, it has breathing-holes along the back, adjoining each ring; but it is withont bones, without eyes, without ears, and properly without feet. It has a mouth, and also an alimentary canal, which runs along to the very point of the tail. In some worms, however, particularly such as are found in the bodies of animals, this canal opens towards the middle of the belly, at some distance from the tail. The intestines of the earth-

worm are always found filled with a very fine earth, which seems to be the only nourishment these animals are capable of receiving.

The animal is entirely without brain, but near the head is placed the heart, which is seen to beat with a very distinct motion, and round it are the spermatic vessels, forming a number of little globules, containing a milky fluid, which have an opening into the belly, not far from the head: they are also often found to contain a number of eggs, which are laid in the earth, and are hatched in twelve or fourteen days into life by the genial warmth of their situation. Like snails, all these animals unite in themselves both sexes at once, the reptile that impregnates being impregnated in turn: few that walk out but must have observed them with their heads laid against each other, and so strongly attached that they suffer themselves to be trod upon.

When the eggs are laid in the earth, which in about fourteen days, as has been said, are hatched into maturity, the young ones come forth very small, but perfectly formed, and suffer no change during their existence: how long their life continues is not well known, but it certainly holds for more than two or three seasons. During the winter they bury themselves deeper in the earth, and seem in some measure to share the general torpidity of the insect tribe. In spring they revive with the rest of nature, and on those occasions, a moist or dewy evening brings them forth from their retreats, for the universal purposes of continuing their kind. They chiefly live in a light, rich, and fertile soil, moistened by dews or accidental showers, but avoid those places where the water is apt to lie on the surface of the earth, or where the clay is too stiff for their easy progression under ground.

Helpless as they are formed, yet they seem very vigilant in avoiding those animals that chiefly make them their prey; in particular, the mole, who feeds entirely upon them beneath the surface, and who seldom ventures, from the dimness of its sight, into the open air,—him they avoid, by darting up from the earth the instant they feel the ground move; and fishermen who are well acquainted with this, take them in what numbers they choose, by stirring the earth where they expect to find them. They are also driven from their retreats under ground by pouring bitter or acrid water thereon, such as that water in which green walnuts have been steeped, or a ley made of potashes.

Such is the general outline of the history of these reptiles, which, as it should seem, degrades them no way beneath the rank of other animals of the insect creation; but we now come to a part of their history which proves the imperfection of their organs, from the easiness with which these little machines may be damaged and repaired again. It is well known in mechanics, that the finest and most complicated instruments are the most easily put out of order, and the most difficultly set aright; the same also obtains in the animal machine. Man, the most complicated machine of all others, whose nerves are more numerous, and powers of action more

various, is most easily destroyed: he is seen to die under wounds which a quadruped or bird could easily survive; and as we descend gradually to the lower ranks, the ruder the composition, the more difficult it is to disarrrange it. Some animals live without their limbs, and often are seen to reproduce them; some are seen to live without their brain for many weeks together; caterpillars continue to increase and grow large, though all their nobler organs are entirely destroyed within; some animals continue to exist though cut in two, their nobler parts preserving life, while the others perish that were cut away: but the earth-worm, and all the zoophyte tribe, continue to live in separate parts, and one animal, by the means of cutting, is divided into two distinct existences, sometimes into a thousand.

There is no phenomenon in all natural history more astonishing than this, that man, at pleasure, should have a kind of creative power, and out of one life make two, each completely formed, with all its apparatus and functions; each with its perceptions, and powers of motion and self-preservation; each as complete in all respects as that from which it derived its existence, and equally enjoying the humble gratifications of its nature.

When Des Cartes first started the opinion, that brutes were machines, the discovery of this surprising propagation was unknown, which might, in some measure, have strengthened his fanciful theory. What is life, in brutes, he might have said, or where does it reside? In some we find it so diffused, that every part seems to maintain a vivacious principle, and the same animal appears possessed of a thousand distinct irrational souls at the same time. But let us not, he would say, give so noble a name to such contemptible powers, but rank the vivifying principle in these with the sap that rises in vegetables, or the moisture that contracts a cord, or the heat that puts water into motion! Nothing, in fact, deserves the name of soul, but that which reasons, that which understands, and by knowing God, receives the mark of its currency, and is minted with the impression of its Creator.

Such might have been the speculations of this philospher; however, to leave theory, it will be sufficient to say, that we owe the first discovery of this power of reproduction in animals to Mr. Trembley, who first observed it in the polypus; and, after him, Spalanzani and others found it taking place in the earth-worm, the sea-worm, and several other ill-formed animals of a like kind, which were susceptible of this new mode of propagation. This last philosopher has tried several experiments upon the earth-worm, many of which succeeded according to his expectation. Every earth-worm, however, did not retain the vivacious principle with the same obstinacy: some, when cut in two, were entirely destroyed; others survived only in the nobler part, and while the head was living the tail entirely perished, and a new one was seen to bourgeon from the extremity. But what was most surprising of all, in some, particularly in the small red-headed earth-worm, both extremities survived

the operation; the head produced a tail, with the anus, the intestines, the annular muscles, and the prickly beards; the tail part, on the other hand, was seen to shoot forth the nobler organs, and in less than the space of three months sent forth a head and heart, with all the apparatus and instruments of generation. This part, as may easily be supposed, was produced much more slowly than the former, a new head taking above three or four months for its completion, a new tail being shot forth in less than as many weeks. Thus two animals, by dissection, were made out of one, each with their separate appetites, each endued with life and motion, and seemingly as perfect as that single animal from whence they derived their origin.

What was performed upon the earth-worm, was found to obtain also in many other of the vermicular species. The sea-worm, the white water-worm, and many of those little worms with feelers found at the bottom of dirty ditches—in all these the nobler organs are of such little use, that if taken away, the animal does not seem to feel the want of them; it lives in all its parts, and in every part, and by a strange paradox in nature, the most useless and contemptible life is of all others the most difficult to destroy.

CHAPTER III.

OF THE STAR-FISH.

THE next order of zoophytes is that of the Star-fish,—a numerous tribe, shapeless and deformed, assuming at different times different appearances. The same animal that now appears round like a ball, shortly after flattens as thin as a plate. All of this kind are formed of a semi-transparent gelatinous substance, covered with a thin membrane, and to an inattentive spectator, often appear like a lump of inanimate jelly, floating at random upon the surface of the sea, or thrown by chance on shore at the departure of the tide. But upon a more minute inspection, they will be found possessed of life and motion; they will be found to shoot forth their arms in every direction, in order to seize upon such insects as are near, and to devour them with great rapacity. Worms, the spawn of fish, and even muscles themselves, with their hard resisting shell, have been found in the stomachs of these voracious animals; and what is very extraordinary, though the substance of their own bodies be almost as soft as water, yet they are no way injured by swallowing these shells, which are almost of a stony hardness. They increase in size as all other animals do. In summer, when the water of the sea is warmed by the heat of the sun, they float upon the surface, and in the dark they send forth a kind of shining light resembling that of phos-

phorus. Some have given these animals the name of sea-nettles, because they burn the hands of those that touch them, as nettles are found to do. They are often seen fastened to the rocks, and to the largest sea-shells, as if to derive their nourishment from them. If they be taken and put into spirit of wine, they will continue for many years entire; but if they be left to the influence of the air, they are, in less than four-and-twenty hours, melted down into limpid and offensive water.

In all of this species, none are found to possess a vent for their excrements, but the same passage by which they devour their food, serves for the ejection of their fæces. These animals, as was said, take such a variety of figures, that it is impossible to describe them under one determinate shape; but in general their bodies resemble a truncated cone, whose base is applied to the rock to which they are found usually attached. Though generally transparent, yet they are found of different colours, some inclining to green, some to red, some to white, and some to brown. In some, their colours appear diffused over the whole surface; in some, they are often streaked, and in others often spotted. They are possessed of a very slow progressive motion, and in fine weather they are continually seen stretching out and fishing for prey. Many of them are possessed of a number of long slender filaments, in which they entangle any small animals they happen to approach, and thus draw them into their enormous stomachs, which fill the whole cavity of their bodies. The harder shells continue for some weeks undigested; but at length they undergo a kind of maceration in the stomach, and become a part of the substance of the animal itself. The indigestible parts are returned by the same aperture by which they were swallowed, and then the star-fish begins to fish for more. These also may be cut in pieces, and every part will survive the operation; each becoming a perfect animal, endued with its natural rapacity. Of this tribe, the number is various, and the description of each would be tedious and uninstructing: the manners and nature of all are nearly as described; but I will just make mention of one creature, which, though not properly belonging to this class, yet is so nearly related, that the passing it in silence would be an unpardonable omission.

Of all other animals, the Cuttle-fish, though in some respects superior to this tribe, possesses qualities the most extraordinary. It is about two feet long, covered with a very thin skin, and its flesh composed of a gelatinous substance which, however, withinside is strengthened by a strong bone, of which great use is made by the goldsmiths. It is possessed of eight arms, which it extends, and which are probably of service to it in fishing for its prey: while in life, it is capable of lengthening or contracting these at pleasure; but when dead, they contract and lose their rigidity. They feed upon small fish, which they seize with their arms; and they are bred from eggs, which are laid upon the weeds along the sea-shore.

The cuttle-fish is found along many of the coasts of Europe, but are not easily caught, from a contrivance with which they are furnished by nature; this is a black substance, of the colour of ink, which is contained in a bladder, generally on the left side of the belly, and which is ejected in the manner of an excrement from the anus. Whenever, therefore, this fish is pursued, and when it finds a difficulty of escaping, it spurts forth a great quantity of this black liquor, by which the waters are totally darkened, and then it escapes, by lying close at the bottom. In this manner the creature finds its safety; and men find ample cause for admiration, from the great variety of stratagems with which creatures are endued for their peculiar preservation.

CHAPTER IV.

OF THE POLYPUS.

THOSE animals which we have described in the last chapter are variously denominated. They have been called the Star-fish, Sea-nettles, and Sea-polypi. This last name has been peculiarly ascribed to them by the ancients, because of the number of feelers, or feet, of which they are all possessed, and with which they have a slow progressive motion; but the moderns have given the name of Polypus to a reptile that lives in fresh water, by no means so large or observable. These are found at the bottom of wet ditches, or attached to the under surface of the broad-leafed plants that grow and swim on the waters. The same difference holds between these and the sea water polypus, as between all the productions of the sea, and of the land and the ocean. The marine vegetables and animals grow to a monstrous size. The eel, the pike, or the bream of fresh waters, is but small; but in the sea they grow to an enormous magnitude. The herbs of the field are at most but a few feet high; those of the sea often shoot forth a stalk of a hundred. It is so between the polypi of both elements: Those of the sea are found from two feet in length to three or four, and Pliny has even described one, the arms of which were no less than thirty feet long. Those in fresh waters, however, are comparatively minute; at their utmost size, seldom above three parts of an inch long, and when gathered up into their usual form, not above a third even of those dimensions.

It was upon these minute animals that the power of dissection was first tried in multiplying their numbers. They had been long considered as little worthy the attention of observers, and were consigned to that neglect in which thousands of minute species of insects remain to this very day. It is true, indeed, that Reaumur observed, classed, and named them. By contemplating their motions, he was enabled distinctly to pronounce on their being of the animal and not of the vegetable kingdom; and he called them

pi, from the great resemblance to those larger ones that were ...d in the ocean. Still, however, their properties were neglected, and their history unknown.

Mr. Trembley was the person to whom we owe the first discovery of the amazing properties and powers of this little vivacious creature: he divided this class of animals into four different kinds; into those inclining to green, those of a brownish cast, those of a flesh colour, and those which he calls the Polype de Panache. The differences of structure in these, as also of colour, are observable enough; but the manner of their subsisting or seizing their prey, and of their progagation, is pretty nearly the same in all.

Whoever has looked with care into the bottom of a wet ditch, when the water is stagnant, and the sun has been powerful, may remember to have seen many little transparent lumps of jelly, about the size of a pea, and flatted on one side: such also as have examined the under side of the broad-leafed weeds that grow on the surface of the water, must have observed them studded with a number of these little jelly-like substances, which were probably then disregarded, because their nature and history were unknown. These little substances, however, were no other than living polypi gathered up into a quiescent state, and seemingly inanimate, because either undisturbed, or not excited by the calls of appetite to action. When they are seen exerting themselves, they put on a very different appearance from that when at rest. To conceive a just idea of their figure, we may suppose the finger of a glove cut off at the bottom; we may suppose also several threads or horns planted round the edge like a fringe. The hollow of this finger will give us an idea of the stomach of the animal; the threads issuing forth from the edges may be considered as the arms, or feelers, with which it hunts for its prey. The animal, at its greatest extent, is seldom seen above an inch and a half long, but it is much shorter when it is contracted and at rest: it is furnished neither with muscles nor rings, and its manner of lengthening or contracting itself more resembles that of the snail, than worms or any other insect. The polypus contracts itself more or less, in proportion as it is touched, or as the water is agitated in which they are seen. Warmth animates them, and cold benumbs them, but it requires a degree of cold approaching congelation, before they are reduced to perfect inactivity: those of an inch have generally their arms double, often thrice as long as their bodies. The arms, where the animal is not disturbed, and the season not unfavourable, are thrown about in various directions, in order to seize and entangle its little prey; sometimes three or four of the arms are thus employed, while the rest are contracted like the horns of a snail, within the animal's body. It seems capable of giving what length it pleases to these arms; it contracts and extends them at pleasure, and stretches them only in proportion to the remoteness of the object it would seize.

These animals have a progressive motion, which is performed by that power they have of lengthening and contracting themselves at

pleasure; they go from one part of the bottom to another; they mount along the margin of the water, and climb up the side of aquatic plants. They often are seen to come to the surface of the water, where they suspend themselves by their lower end. As they advance but very slowly, they employ a great deal of time in every action, and bind themselves very strongly to whatever body they chance to move upon as they proceed; their adhesion is voluntary, and is probably performed in the manner of a cupping-glass applied to the body.

All animals of this kind have a remarkable attachment to turn towards the light, and this naturally might induce an inquirer to look for their eyes; but however carefully this search has been pursued, and however excellent the microscope with which every part was examined, yet nothing of the appearance of this organ was found over the whole body; and it is most probable that, like several other insects which hunt their prey by their feeling, these creatures are unfurnished with advantages which would be totally useless for their support.

In the centre of the arms, as was said before, the mouth is placed, which the animal can open and shut at pleasure; and this serves at once as a passage for food, and an opening for it after digestion. The inward part of the animal's body seems to be one great stomach, which is open at both ends; but the purposes which the opening at the bottom serves are hitherto unknown, but certainly not for excluding their excrements, for these are ejected at the aperture by which they are taken in. If the surface of the body of this little creature be examined with a microscope, it will be found studded with a number of warts, as also the arms, especially when they are contracted; and these tubercles, as we shall presently see, answer a very important purpose.

If we examine their way of living, we shall find these insects chiefly subsisting upon others, much less than themselves, particularly a kind of millepedes that live in the water, and a very small red worm which they seize with great avidity. In short, no insect whatsoever, less than themselves, seems to come amiss to them; their arms, as was said before, serve them as a net would a fisherman, or perhaps more exactly speaking, as a lime-twig does a fowler. Wherever their prey is perceived, which the animal effects by its feeling, it is sufficient to touch the object it would seize upon, and it is fastened without a power of escaping. The instant one of this insect's long arms is laid upon a millepede, the little insect sticks without a possibility of retreating. The greater the distance at which it is touched, the greater is the ease with which the polypus brings the prey to its mouth. If the little object be near, though irretrievably caught, it is not without great difficulty that it can be brought up to the mouth and swallowed. When the polypus is unsupplied with prey, it testifies its hunger by opening its mouth; the aperture, however, is so small, that it cannot be easily perceived; but when, with any of its long arms, it has seized

upon its prey, it then opens the mouth distinctly enough, and this opening is always in proportion to the size of the animal which it would swallow; the lips dilate insensibly by small degrees, and adjust themselves precisely to the figure of their prey. Mr. Trembley, who took a pleasure in feeding this useless brood, found that they could devour aliments of every kind, fish and flesh, as well as insects; but he owns they did not thrive so well upon beef and veal, as upon the little worms of their own providing. When he gave one of these famished reptiles any substance which was improper to serve for aliment, at first it seized the prey with avidity, but after keeping it some time entangled near the mouth, it dropped it again with distinguishing nicety.

When several polypi happen to fall upon the same worm, they dispute their common prey with each other. Two of them are often seen seizing the same worm at different ends, and dragging it at opposite directions with great force. It often happens, that while one is swallowing its respective end, the other is also employed in the same manner, and thus they continue swallowing each his part until their mouths meet together; they then rest, each for some time in this situation, till the worm breaks between them, and each goes off with his share. But it often happens that a seemingly more dangerous combat ensues when the mouths of both are thus joined upon one common prey together; the largest polypus then gapes and swallows his antagonist; but what is very wonderful, the animal thus swallowed seems to be rather a gainer by the misfortune. After it has lain in the conqueror's body for about an hour, it issues unhurt, and often in possession of the prey which had been the original cause of contention: How happy would it be for men, if they had as little to fear from each other!

These reptiles continue eating the whole year, except when the cold approaches to congelation; and then, like most others of the insect tribe, they feel the general torpor of nature, and all their faculties are for two or three months suspended; but if they abstain at one time, they are equally voracious at another, and like snakes, ants, and other animals that are torpid in winter, the meal of one day suffices them for several months together. In general, however, they devour more largely in proportion to their size, and their growth is quick exactly as they are fed; such as are the best supplied soonest acquire the largest size, but they diminish also in their growth with the same facility if their food be taken away.

Such are the more obvious properties of these little animals; but the most wonderful still remain behind—their manner of propagation, or rather multiplication, has for some years been the astonishment of all the learned of Europe. They are produced in as great a variety of manners as every species of vegetable. Some polypi are propagated from eggs, as plants are from their seed; some are produced by buds issuing from their bodies, as plants are produced by inoculation; while all may be multiplied by cuttings, and this to a degree of minuteness that exceeds even philosophical perseverance.

With respect to such of this kind as are hatched from the egg, little curious can be added, as it is a method of propagation so common to all the tribes of insect nature; but with regard to such as are produced like buds from their parent stem, or like cuttings from an original root, their history requires a more detailed explanation. If a polypus be carefully observed in summer, when these animals are chiefly active, and more particularly prepared for propagation, it would be found to bourgeon forth from different parts of its body several tubercles or little knobs, which grow larger and larger every day: after two or three days' inspection, what at first appeared but a small excrescence takes the figure of a small animal, entirely resembling its parent, furnished with feelers, a mouth, and all the apparatus for seizing and digesting its prey. This little creature every day becomes larger, like the parent, to which it continues attached; it spreads its arms to seize upon whatever insect is proper for aliment and devours it for its own particular benefit: thus it is possessed of two sources of nourishment—that which it receives from the parent by the tail, and that which it receives from its own industry by the mouth. The food which these animals receive often tinctures the whole body, and upon this occasion the parent is often seen communicating a part of its own fluids to that of its progeny that grows upon it; while, on the contrary, it never receives any tincture from any substance that is caught and swallowed by its young. If the parent swallows a red worm, which gives a tincture to all its fluids, the young one partakes of the parental colour; but if the latter should seize upon the same prey, the parent polypus is no way benefited by the capture, but all the advantage remains with the young one.

But we are not to suppose that the parent is capable of producing only one at a time; several young ones are thus seen at once, of different sizes, growing from its body, some just budding forth, others acquiring their perfect form, and others come to sufficient maturity, and just ready to drop from the original stem to which they had been attached for several days. But what is more extraordinary still, those young ones themselves that continue attached to their parent, are seen to bourgeon and propagate their own young ones also, each holding the same dependence upon its respective parent, and possessed of the same advantages, that have been already described in the first connexion. Thus we see a surprising chain of existence continued, and numbers of animals naturally produced without any union of the sexes, or other previous disposition of nature.

This seems to be the most natural way by which these insects are multiplied, their production from the egg being not so common; and though some of this kind are found with a little bladder attached to their bodies, which is supposed to be filled with eggs which afterwards come to maturity, yet the artificial method of propagating these animals is much more expeditious, and equally certain: it is indifferent whether one of them be cut into ten or ten hundred

parts, each becomes as perfect an animal as that which was originally divided; but it must be observed, that the smaller the part which is separated from the rest, the longer it will be in coming to maturity, or in assuming its perfect form. It would be endless to recount the many experiments that have been tried upon this philosophical prodigy: the animal has been twisted and turned into all manner of shapes; it has been turned inside out, it has been cut in every direction; yet still it continued to move, its parts adapted themselves again to each other, and in a short time it became as voracious and industrious as before.

Besides these kinds mentioned by Mr. Trembley, there are various others which have been lately discovered by the vigilance of succeeding observers, and some of these so strongly resemble a flowering vegetable in their forms, that they have been mistaken by many naturalists for such. Mr. Hughes, the author of the Natural History of Barbadoes, has described a species of this animal, but has mistaken its nature, and called it a sensitive flowering plant; he observed it to take refuge in the holes of rocks, and, when undisturbed, to spread forth a number of ramifications, each terminated by a flowery petal, which shrunk at the approach of the hand, and withdrew into the hole from whence before it had been seen to issue. This plant, however, was no other than an animal of the polypus kind, which is not only to be found in Barbadoes, but also on many parts of the coast of Cornwall, and along the shores of the Continent.

CHAPTER V.

OF THE LYTHOPHYTES AND SPONGES.

It is very probable that the animals we see, and are acquainted with, bear no manner of proportion to those that are concealed from us. Although every leaf and vegetable swarms with animals upon land, yet at sea they are still more abundant; for the greatest part of what would seem vegetables growing there, are in fact nothing but the artificial formation of insects, palaces which they have built for their own habitation.

If we examine the bottom of the sea along some shores, and particularly at the mouths of several rivers, we shall find it has the appearance of a forest of trees under water, millions of plants growing in various directions, with their branches entangled in each other, and sometimes standing so thick as to obstruct navigation. The shores of the Persian Gulf, the whole extent of the Red Sea, and the western coasts of America, are so choaked up in many places with these coraline substances, that though ships force a passage through them, boats and swimmers find it impossible to

make their way. These aquatic groves are formed of different substances, and assume various appearances. The coral plants, as they are called, sometimes shoot out like trees without leaves in winter; they often spread out a broad surface like a fan, and not uncommonly a large bundling head, like a faggot; sometimes they are found to resemble a plant with leaves and flowers, and often the antlers of a stag, with great exactness and regularity. In other parts of the sea are seen sponges of various magnitude and extraordinary appearances, assuming a variety of fantastic forms, like large mushrooms, mitres, fonts, and flower-pots. To an attentive spectator these various productions seem entirely of the vegetable kind; they seem to have their leaves and their flowers, and have been experimentally known to shoot out branches in the compass of a year. Philosophers, therefore, till of late thought themselves pretty secure in ascribing these productions to the vegetable kingdom; and Count Marsigli, who has written very laboriously and learnedly upon the subject of corals and sponges, has not hesitated to declare his opinion, that they were plants of the aquatic kind, furnished with flowers and seeds, and endued with a vegetation entirely resembling that which is found upon land. This opinion, however, some time after, began to be shaken by Rumphius and Jussieu, and at last by the ingenious Mr. Ellis, who, by a more sagacious and diligent inquiry into nature, put it past doubt, that corals and sponges were entirely the work of animals, and that, like the honey-comb which was formed by the bee, the coral was the work of an infinite number of reptiles of the polypus kind, whose united labours were thus capable of filling whole tracts of the ocean with those embarrassing tokens of their industry.

If, in our researches after the nature of these plants, we should be induced to break off a branch of the coraline substance, and observe it carefully, we shall perceive its whole surface, which is very rugged and irregular, covered with a mucous fluid, and almost in every part studded with little jelly-like drops, which, when closely examined, will be found to be no other than reptiles of the polypus kind. These have their motions, their arms, their appetites, exactly resembling those described in the last chapter; but they soon expire when taken out of the sea, and our curiosity is at once stopped in its career, by the animals ceasing to give any mark of their industry: recourse therefore has been had to other expedients, in order to determine the nature of the inhabitants, as well as the habitation.

If a coraline plant be strictly observed while still growing in the sea, and the animals upon its surface be not disturbed, either by the agitation of the waters or the touch of the observer, the little polypi will then be seen in infinite numbers, each issuing from its cell, and in some kinds, the head covered with a little shell resembling an umbrella, the arms spread abroad in order to seize its prey, while the hinder part still remains attached to its habita-

from whence it never wholly removes. By this time it is ived that the number of inhabitants is infinitely greater than t first suspected, and that they are all assiduously employed ne same pursuits, and that they issue from their respective cells d retire into them at pleasure. Still, however, there are no proofs these large branches which they inhabit are entirely the con- on of such feeble and minute animals. But chemistry will nd to lend a clue to extricate us from our doubts in this cular. Like the shells which are formed by snails, muscles, oysters, these coraline substances effervesce with acids, and therefore well be supposed to partake of the same animal ire. But Mr. Ellis went still farther, and examined their ations just as they were beginning. Observing an oyster-bed h had been for some time neglected, he there perceived the first ments of a coraline plantation, and tufts of various kinds ting from different parts of this favourable soil. It was upon he tried his principal experiment. He took out the oysters h were thus furnished with coralines, and placed them in a wooden vessel, covering them with sea water. In about an he perceived the animals, which before had been contracted handling, and had shown no signs of life, expanding themselves very direction, and appearing employed in their own natural manner. Perceiving them therefore in this state, his next aim was to preserve them thus expanded, so as to be permanent objects of curiosity. For this purpose he poured, by slow degrees, an equal quantity of boiling water into the vessel of sea water in which they were immersed. He then separated each polypus with pincers from its shell, and plunged each separately into small crystal vases, filled with spirit of wine mixed with water. By this means the animal was preserved entire, without having time to contract itself, and he thus perceived a variety of kinds, almost equal to that variety of productions which these little animals are seen to form. He has been thus able to perceive and describe fifty different kinds, each of which is seen to possess its own peculiar mode of construction, and to form a coraline that none of the rest can imitate. It is true, indeed, that on every coraline substance there are a number of polypi found, no way resembling those which are the erecters of the building; these may be called a vagabond race of reptiles, that are only intruders upon the labours of others, and that take possession of habitations, which they have neither art nor power to build for themselves. But, in general, the same difference that subsists between the honey-comb of the bee and the paper-like cells of the wasp, subsists between the different habitations of the coral-making polypi.

With regard to the various forms of these substances, they have obtained different names, from the nature of the animal that produced them, or the likeness they bear to some well-known object, such as coralines, fungi-madrepores, sponges, astroites, and keratophytes. Though these differ extremely in their outward appear-

ances, yet they are all formed in the same manner by reptiles of various kinds and nature. When examined chemically they discover the marks of animal formation; the corals, as was said, dissolve in acids, the sponges burn with an odour strongly resembling that of burnt horn. We are left somewhat at a loss with regard to the precise manner in which this multitude of cells, which at last assume the appearance of a plant or flower, are formed. If we may be led in this subject by analogy, it is most probable that the substance of coral is produced in the same manner that the shell of the snail grows round it: these little reptiles are each possessed of a slimy matter, which covers its body, and this hardening, as in the snail, becomes an habitation exactly fitted to the body of the animal that is to reside in it; several of these habitations being joined together, form at length a considerable mass, and as most animals are productive in proportion to their minuteness, so these multiplying in a surprising degree, at length form those extensive forests that cover the bottom of the deep.

Thus all nature seems replete with life; almost every plant on land has its surface covered with millions of these minute creatures, of whose existence we are certain, but of whose uses we are entirely ignorant; while numbers of what seem plants at sea are not only the receptacles of insects, but also entirely of insect formation. This might have led some late philosophers into an opinion, that all nature was animated; that every, even the most inert mass of matter, was endued with life and sensation, but wanted organs to make those sensations perceptible to the observer: those opinions, taken up at random, are difficultly maintained, and as difficultly refuted; like combatants that meet in the dark, each party may deal a thousand blows without ever reaching the adversary. Those perhaps are wiser who view nature as she offers; who, without searching too deeply into the recesses in which she ultimately hides, are contented to take her as she presents herself, and storing their minds with effects rather than with causes, instead of the embarrassment of systems, about which few agree, are contented with the history of appearances concerning which all mankind have but one opinion.

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Bat, as big as a rabbit, i. 177. By some reckoned among birds, i. 300. Doubtful among naturalists whether beast or bird; now universally takes place among quadrupeds; Pliny, Gesner, and Aldrovandus, placed it among birds; scarcely in any particular resembles the bird, except the power of sustaining itself in the air; description of the common sort in England; its intestines and skeleton in some measure resemble those of mankind; makes its first appearance early in summer, and begins its flight in the evening; is seen to skim along the surface of waters; feeds upon gnats, moths, and nocturnal insects of every kind, which it pursues open mouthed; its flight laborious, irregular, and, if interrupted, not readily followed by a second elevation; usually taken when, striking against an object, it falls to the ground; even in the summer it sleeps the greatest part of the time; its retreat; continues in a

torpid state during winter; is usually hanging by its hooked claws to the roofs of caves, unaffected by all changes of weather; is destroyed particularly by the owl; the bat couples and brings forth in summer from two to five young at a time; the female has two nipples forward on the breast, as in the human kind, and this a motive for Linnæus to give it the title of a primas, to rank it in the same order with mankind; the female makes no nest for her young; when she begins to grow hungry, and finds a necessity of stirring abroad, she takes her little ones and sticks them by their hooks against the sides of her apartment, and there they immoveably cling, and patiently wait her return; less similitude to the race of birds than of quadrupeds; great labour in flying, soon fatigues, and tires it in less than an hour; its petty thefts upon the fat of bacon; long-eared bat; horse-shoe bat; rhinoceros bat; a large race of bats in the East and West Indies truly formidable; a dangerous enemy; when united in flocks they become dreadful; they are eaten; the Negroes of the African coasts will not eat them though starving; on the African coasts they fly in such numbers as to obscure the setting sun; the rousette, or great bat of Madagascar, is found upon the coast of Africa and Malabar, where it is often seen about the size of a large hen; destroys the ripe fruits, and sometimes settles upon animals, and man himself; destroys fowls and domestic animals, unless preserved with the utmost care, and often fastens upon the inhabitants, attacks them in the face, and makes terrible wounds; the ancients have taken their idea of harpies from these fierce and voracious creatures, equally deformed, greedy, uncleanly, and cruel; the bat called the American vampyre, its description by Ulloa; purport of his account confirmed by various travellers, who all agree that it has a faculty of drawing blood from persons sleeping, and destroying them before they awake; a strong difficulty remains how they make the wound; Ulloa and Buffon's opinions suppose the animal endowed with a strong power of suction, and that, without inflicting any wound, by continuing to draw, it enlarges the pores of the skin, so that the blood at length passes; they are one of the greatest pests of South America, ii. 115. Found in the holes deserted by the woodpecker, 307

Bath, persons coming out of a warm bath several ounces heavier than they went in; warm bath of sea water a kind of relief to mariners upon a failure of fresh water at sea, i. 103

Bay, a stag is said *to bay*, when he turns his head against the hounds, i. 386.

Beagle. See *Hound*, ii. 6

Beak, how that of animals is produced, i. 215

Beam, by hunters meant that part which bears the antlers, i. 384

Beams, those of the sun shining upon the fire put it out, and why; darting directly upon us, without the medium of the air, would burn us up at once, or blind us with effulgence, i. 143

Beards, Americans take great pains to pluck theirs up by the roots, the under part, and all but the whiskers, therefore supposed to have no hair growing on that part; Linnæus himself has fallen into this mistake; different customs of men in the manner of wearing their beards, i. 213

Bears, in cold frozen regions of the North not smaller than in milder countries, i. 177. The North American Indians anoint their skins with fat of bears, 270. The bears now and then make depredations upon the rein-deer, 407. In Greenland do not change colour, ii. 37. The black, of America, does not reject animal food, as believed; places where they are found; retreat of the brown-bear; a vulgar error that, during winter, the brown bear lives by sucking its paws; it seems rather to subsist then upon the exuberance of its former flesh; the male and female do not inhabit the same den, and seldom are seen together but upon the accesses of genial desire; care of the female for her young; the bear when tamed seems gentle and placid, yet still to be distrusted and managed with caution, being often treacherous and resentful without a cause; is capable of a degree of instruction; when come to maturity can never be tamed; methods of taking them; their paws and hams a great delicacy; the white, placed in the coldest climates, grows larger than in the temperate zones,

and remains master of the icy mountains in Spitzbergen and Greenland; unable to retreat, when attacked with fire-arms, they make a fierce and long resistance; they live upon fish and seal; their flesh is too strong for food; are often seen on ice-floats, several leagues at sea, though bad swimmers; the white sometimes jumps into a Greenlander's boat, and if it does not overset it, sits down calmly, and, like a passenger, suffers itself to be rowed along; hunger makes it swim after fish; often a battle ensues between a bear and a morse, or a whale, and the latter generally proves victorious, ii. 191, &c.

Beasts are most fierce and cruel in all countries where men are most barbarous, i. 307

Beasts of chase, in the reigns of William Rufus, and Henry the First, it was less criminal to destroy one of the human species than a beast of chase; sacred edifices thrown down, and turned to waste, to make room for beasts of chase, i. 382

Beasts of prey seldom devour each other; they chiefly seek after the deer or the goat; their usual method of hunting, i. 303

Beaver, known to build like an architect, and rule like a citizen, i. 306. Its fore parts taste like flesh and the hinder like the fish it feeds on, 416. A remaining monument of brutal society; its qualities, taken from its fellows, and kept in solitude or domestic tameness; resist only when driven to extremity, and fights when its speed cannot avail; the only quadruped that has a flat broad tail, covered with scales, and serving as a rudder to direct its motions in the water; the sole quadruped with membranes between the toes on the hind feet and none on the fore feet; the only animal in its fore parts entirely resembling a quadruped, and in its hinder parts approaches the nature of fishes, having a scaly tail; its description; has but one vent for the emission of excrements and urine; they assemble about the months of June and July; make a society, to continue the greatest part of the year; form a company for above two hundred; fix their abode by the side of a lake or river; cut with their teeth a tree thicker than a man's body; amazing work and mansion houses; convey their materials by water; mix clay and dry grass together, work it into a mortar, and with their tails plaster their work within and without; their walls perpendicular, and two feet thick; their piercers four score or an hundred feet long, and ten or twelve feet thick at the base; their dikes ten and twelve feet thick at the foundation; their apartments round or oval, and divided into three stories, one above the other; visited too often by men, they work only in the night-time, or abandon the place, and seek a safer situation; four hundred reside in one mansion house, divided into a number of apartments having communication with each other; their works in the northern parts finished in August or September; in summer they are epicures; their provisions for the winter season; they drive piles into the earth to fence and fortify their habitation against the wind and water; cut down branches from three to ten feet in length; the largest are conveyed to the magazines by a whole body, the smallest by one only, each taking a different way, and having a walk assigned him, that no one should interrupt another in his work; wood-yards larger or smaller in proportion to the number in family; manner of catching them in snares, or by surprise; they swim with their mortar on their tails, and their stakes between their teeth; their works, damaged by force of water, or feet of huntsmen, instantly repaired, ii. 124, &c.

Beauty, every country has peculiar ideas of beauty; extraordinary tastes for beauty; every nation, how barbarous soever, has peculiar arts of heightening beauty; several of these arts, i. 205. A modern lady's face, formed exactly like the Venus of Medicis, or the Sleeping Vestal, would scarcely be considered as a beauty, except by the lovers of antiquity; less in the object than in the eye of the beholder; superior beauty of our ancestors not easily comparable, 281.

Beccafigo, a bird of the sparrow kind, ii. 333.

Bed of a river, an increase of water there increases its rapidity, except in cases of inundation, and why; such bed left dry for some hours by a violent storm blowing directly against the stream, i. 89.

Beds, the earth every where in beds over beds, and each of them maintaining exactly the same thickness, i. 27

Bee, a ruminating insect, or seemingly so; its stomach is composed of muscular fibres, i. 336. Operations studied for two thousand years are still incompletely known; Reaumur's account sufficiently wonderful; many of the facts held dubious by those conversant with the subject; some declared not to have existence in nature; three different kinds of bees; common working been neither male nor female; queen bees lay all the eggs that are hatched in a season; structure of the working bee, particularly of its trunk, which extracts the honey from flowers; manner of building their cells; in one day they make cells upon each other enough to contain three thousand bees; description of those cells; the combs made by insensible degrees, not at once, as some imagine; the cells for the young and for the drones; that for the queen bee the largest of all; those for honey are deeper than the rest; that not the only food upon which they subsist; manner of anticipating the progress of vegetation; the bee has a stomach for wax as well as honey; bee bread; treacle for food of bees in winter; what part of the flower has the honey; sting of the bee; one wanting food bends down its trunk to the bee from whom it is expected, which then opens its honey bag, and lets some drops fall into the other's mouth; numerous as the multitude of bees appear in a swarm, they all owe their origin to one parent, called the queen bee; opening the body of a queen the eggs at one time found to amount to five thousand; the queen easily distinguished from the rest; great fertility of the queen, and the great attentions paid to her, controverted by recent observers; they leave a cell to every egg, and destroy the rest; great care and affection for the young; in about twenty days after the egg was laid, the bee was completely formed and fitted to undergo the fatigues of its state; the cell being prepared, the animal soon transformed into an aurelia, different from that of the common caterpillar; when they begin to break their prisons, above a hundred are excluded in one day; dreadful battle often ensues between the young brood and their progenitors; signs previous to their migrations; after the migration, the queen being settled, the swarm follows, and in a quarter of an hour the whole body is at ease; sometimes sacrifice their queen, but never when the hive is full of wax and honey; the working sort kill the drones in the worm state, in the cell, and eject their bodies from the hive among the general carnage; upwards of forty thousand bees found in a single hive; instances of expedition in working; in the first fifteen days they make more wax than during the rest of the year; a hive sending out several swarms in the year, the first always the best and most numerous; a kind of floating bee-house used in France, iii. 273

Bees in other countries. In Gaudaloupe are less by half than in Europe, and have no sting; sometimes there are two or three queens to a swarm, then the weaker deserted for the more powerful protector; the deserted queen does not survive the defeat, is destroyed by her jealous rival, and till this be done the bees never go out to work; at Guadaloupe their cells are in hollow trees, sometimes with a sort of waxen house, shaped like a pear, in which they lodge their honey and lay their eggs; their honey never congeals, is fluid as oil, and has the colour of amber; in the tropical climates are black bees without a sting; their wax is soft, and only used for medicinal purposes, not being hard enough for candles as in Europe; whether the humble-bees have a queen or not, there is one much larger than the rest, without wings, without hair, all over black, like polished ebony; this views all the works from time to time; their habits; the honey gathered by the humble-bees neither so fine, so good, nor the wax so clear or so capable of fusion, as those of the common bees, 283, &c.

—— Leaf-cutting Bees make their nest, and lay their eggs, among bits of leaves, iii. 284

—— Wall Bees, so called because they make their nests in walls; the male and female are of a size; the former without a sting, iii. 285

—— Wood Bee, iii. 284. Mason Bee, ib. Ground Bees build their nests in the earth; the patience and assiduity of their labour, ib.

Beetles, a ruminating insect, or seems to ruminate, i. 336. Their general characteristics. Their kinds, distinguished from each other; description of the dorr-beetle, or the May bug: how the two sexes in the May bug are distinguished from each other; season of their coupling; the female bores a hole into the ground where to deposit her burthen, and when lightened of it ascends to live as before; their eggs; description of the insect, and its manner of life in the worm state; continues in that state for more than three years, changing every year its skin, and living under the ground without eyes; in what manner it assumes the form of a chrysalis; time when it becomes winged and completely formed; the old one never survives the season, and dies from the severity of cold in winter; its habits and food when completely formed; number of their eggs; rooks and hogs particularly fond of them, and devour them in great numbers; instances of great devastations made by the May bug; description and habits of that beetle which the Americans call the Tumble-dung; the insect called the King of the Beetles; description of the elephant beetle, the largest of this kind hitherto known, iii. 300, &c.

Bell, the great diving-bell improved by Dr. Halley; he could write or read in it when the sea was clear, and especially when the sun shone, i. 125

Bell, when the stag cries, he is said *to bell*, i. 384

Bells, their vibrations not heard under the receiver of an air pump, i. 143

Berries, the Laplanders drink water in which juniper berries have been infused, i. 261

Bewailer, or the Sai, a monkey of the new continent, ii. 157

Bezoar, its description, i. 366. German bezoar, 363

Bezoar, goat, the oriental bezoar, i. 366. Cow bezoar, and monkey bezoar; hog bezoar, 367

Billiting, a name given by huntsmen to the excrement of the fox, ii. 25

Birch, hares are particularly fond of it, ii. 61

Bird-catchers, sport by counterfeiting the cry of the owl, ii. 267. Nets for, and method of taking small birds, 329

Birds all produced from the egg, i. 185. Their lower eyelid alone has motion, 208. Have the neck longer than any other kind of animals; those which have short claws have also short necks; those that have long claws have the neck in proportion, 215. Have a power of disgorging food to feed their young; ruminating birds, 355. Many kinds which the dog will not touch, ii. 15. Hunters often informed by the birds of the place of retreat of the fox, 26. A flock of small birds often alarms every thicket, and directs the hunter to the martin, 43. Surpass fishes and insects in structure of body and in sagacity; their anatomy and conformation; compared to a ship making way through water; are furnished with a gland behind, containing a proper quantity of oil; to what purpose; description of their feathers, ii. 209, &c. The pectoral muscles of quadrupeds trifling to those of birds; choose to rise against the wind, and why; all, except the nocturnal, have the head smaller, and less in proportion to the body, than quadrupeds; their sight exceeds most other animals, and excels in strength and precision; have no external ear standing out from the head; the feathers encompassing the ear-holes supply the defect of the exterior ear; the extreme delicacy of their sense of hearing is easily proved by their readiness in learning tunes, or repeating words, and the exactness of their pronunciation; their delicacy in the sense of smelling; instance of it in ducks; the tail guides their flight like a rudder, and assists them either in the ascent or descent; wonderful internal conformation; the wind-pipe often makes many convolutions within the body of the bird, and is then called the labyrinth; of what use these convolutions are, no naturalist has been able to account; this difference obtains in birds to all appearance of the same species; whence some derive that loud and various modulation in their warblings is not easily accounted for; birds have much louder voices, in respect to their bulk, than animals of other kinds: all have properly but one stomach, but different in different kinds; the organs of digestion in a manner reversed in birds; why they pick up sand, gravel, and other hard substances; most have two appendices or blind guts; in quadrupeds always found single; all birds want a

bladder for urine; their urine differs from that of other animals; effects of the annual moulting which birds suffer; their moulting time artificially accelerated, and how; the manner in which nature performs the operation of moulting; their moulting season; many live with fidelity together for a length of time; when one dies the other shares the same fate soon after; the male of wild birds as happy in the young brood as the female; nothing exceeds their patience while hatching; Addison's observations to this purpose; great care and industry in providing subsistence for their young; they feed each of the young in turn, and why; perceiving their nests or young to have been handled, they abandon the place by night, and provide a more secure, though less commodious retreat; the young taught the art of providing for their subsistence; those hatched and sent out earliest in the season the most strong and vigorous; they endeavour to produce early in the spring, and why; efforts for a progeny when their nests are robbed; such as would have laid but two or three eggs, if their eggs be stolen will lay ten or twelve; the greatest number remain in the districts where they have been bred; and are excited to migration only by fear, climate, or hunger; cause of the annual emigrations of birds; times of migrations; in what order performed; follow the weather rather than the country, and go on as they perceive the atmosphere more suitable to their wants and dispositions; in all countries longer lived than quadrupeds or insects of the same climate; surprising age of swans and geese; plumage and voice of birds in different zones; all less than quadrupeds; the greatest of one class surpass the greatest of another in magnitude; causes of the great variety in the middle order of birds; the ostrich is the greatest of birds, the humming-bird the smallest; wild birds generally of the same magnitude and shape; inferior to quadrupeds in docility; difference between land birds and water fowls, 225, &c. Description of birds of the rapacious kind; the pie kind; the poultry kind; the sparrow kind; the duck kind; the crane kind, 226. The nauseous bird, or dodo, 238. Powers of land birds of the rapacious kind to obtain their food; sight of such as prey by day surprisingly quick; such as ravage by night have their sight fitted to see in darkness with precision; inhabit the most lonely places and desert mountains; appearing in cultivated plains, or the warbling groves, is for depredation; every order of carnivorous birds seek for those of the size approaching their own; the carnivorous kinds only breed annually, and are less fruitful than others; breed but few at a time; where supplies of food are difficult, the old soon drive the brood from the nest to shift for themselves, and often destroy them in a fury, caused by hunger; almost all birds of prey unsociable; the male and female, when necessary to each other, live together, but they most usually prowl alone; birds with crooked beaks and talons are solitary; all males of prey are less and weaker than females; the females are of a greater size, more beautiful and lovely for shape and colours, stronger, more fierce and generous than the males; it may be necessary to be thus superior, to provide for herself and her young; these birds are lean and meagre; their flesh is stringy and ill tasted, soon corrupting, and flavoured of that animal upon which they subsist; Bellonius asserts, many people like the flesh of the vulture and falcon, and dress them for eating, and that the osprey when young is excellent food; five kinds of land birds of a rapacious nature; whence the distinctive mark, 239, &c. Bird of heaven, name given by the ancients to the eagle, 244. The most formidable birds of prey respect the butcher bird, 262. The digestion of such as live upon mice, lizards, or the like food, not very perfect, 266. Father Kircher set the voices of birds to music, ib. Domestic birds of the poultry kind, maintained in our yards, are of the foreign extraction, 269. The wilder species cooped or caged, pine away, grow gloomy, and some refuse all sustenance; the poultry kind alone grow fat, 270. Climate, food, and captivity, three very powerful agents in the alteration in the habits and the very form of birds; of all birds, the cock the oldest companion of mankind, and the first reclaimed from the forest, 271. Also the Persian bird of Aristophanes, 272. Description of the tamis, or the bird of Numidia, 285. The bustard the largest land-bird, native of Britain, 286. None secures its young better from external injury than the toucan, 304. God's bird, the bird of paradise, 309.

Parakeets the most beautiful in plumage, and the most talkative birds in nature, 321. The pigeon, for its size, has the largest crop, 324. Small birds mark out a territory to themselves, which they permit none of their own species to remain in; at some seasons of the year, all small birds migrate from one country to another, or from more inland provinces towards the shore; months of their migrations; autumn the principal season for catching these wanderers; the nets and the method of catching them; flur-birds; singing among birds universally the prerogative of the male; small birds fight till one yields his life with the victory; two male birds strive in song till the loudest silences the other; during the contention, the female sits an attentive silent auditor, and often rewards the loudest songster with her company during the season; the male, while his mate is hatching, sits upon some neighbouring tree to watch and to sing; the nests of small birds warmer than of the larger; small birds having finished their nests, nothing exceeds the cunning they employ to conceal it; worms and insects the first food of all birds of the sparrow kind; how birds of the sparrow kind bring forth and hatch their young; manner of life during the rigour of winter; the male of small birds not finding a mate of his own species, flies to one of another, like him left out in pairing; a mixed species between a goldfinch and a canary bird, between a linnet and a lark, these breed frequently together, and produce, not like the mules among quadrupeds, a race incapable of breeding again, but one as fruitful as their parents; various birds of the sparrow kind; many plants propagated from the depositions of birds; many of those kinds which are of passage in England, permanent in other countries; and some, with us constant residents, in other kingdoms have the nature of birds of passage; instances of it, 328, &c. The heron commits the greatest devastation in fresh waters, 365. The flamingo has the largest tongue, 373. Birds of various sorts and sizes, more than the stars in a serene night, seen on the rock of the Bass, in the Firth of Forth, 394. None make a more indifferent figure upon land, or a more beautiful in the water, than the swan, 410. Of all birds known, it is the longest in the shell, 412. An incontestible proof that birds have their manners rather from nature than education, 416

Biscayneers were in possession of the whale-fishery on the coasts of Greenland, in the beginning of the fourteenth century, iii. 22. Their method of taking the whale, ib

Bison and Urus, names of descendants of one common stock; error of the naturalists upon this point; the cow and bison are animals of the same kind; description of the bison; it is supposed by Klein and Buffon no more than another name for the bonassus; the breed found in all the southern parts of the world; that breed more expert and docile than ours; many bend their knees to take burdens up or set them down; the respect for them in India degenerated into adoration; it is nimble of foot; is esteemed by the Hottentots; assists them in attending their flocks, and guarding them against invaders; is taught to combat the enemies of the nation, and every army of the Hottentots is furnished with a herd of them; they procure the Hottentots an easy victory before they strike a blow; lives in the same cottage with its master, and when it dies, a new one is chosen to succeed it by a council of the old men of the village, and is then joined with a veteran of its own kind, from whom it learns, becomes social and diligent, and is taken for life into friendship and protection; the bisons are found to differ from each other in several parts of the world; some have horns, some are without; they are equally tractable and gentle when tamed, and are furnished with a fine, lustrous, soft hair, more beautiful than that of our own breed; their hump of diffhrent sizes, weighing from forty to fifty pounds, more or less; cuts and tastes somewhat like a dressed udder; the bisons of Malabar, Abyssinia, Madagascar, Arabia, Africa, and America; in the course of a few generations, the hump wears away; its description; the bison and the cow breed among each other; the grunting or Siberian cow, and the little African cow or zebu, are different races of the bison, i. 341, &c.

Bitch, a pregnant bitch so placed by M. Buffon, that her puppies were brought forth in warm water, i. 196
Bitches, one forgotten in a country-house, lived forty days without any other nourishment than the wool of a quilt she had torn to pieces, ii. 15
Bittern, or mire-drum, the solemnity of its evening-call cannot be described by words; they are calls to courtship, or of connubial felicity; it differs from the heron chiefly in colour; its wind-pipe fitted for the sound; opinions concerning the cause of its boomings; never utters its call in domestic captivity; its residence; a retired timorous animal; its food, nest, and eggs; in three days, leads its little ones to their food; differences between the bittern and the heron; its hollow boom considered by the vulgar as the presage of some sad event; instance of it; its flesh greatly esteemed among the luxurious; it seldom rises but when almost trod upon; at the latter end of autumn, in the evening, its wonted indolence forsakes it; is then seen rising in a spiral ascent, till quite lost from the view, making a singular noise, different from its former boomings; names given to this bird by the Greeks and Latins, ii. 367
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Black-cap, bird of the sparrow kind, ii. 395. Prized by some for its singing, and is also called the Mock Nightingale, 345
Blacks, conjectural opinion that the blacks are a race of people bred from one man accidentally black; the climate a cause obvious and sufficient to produce blackness; nothing satisfactory discovered upon the cause producing it in human complexions; opinion of Sir Thomas Brown upon the subject, i. 268. Whence originally their flat noses, 271. Black parents have procreated two white negroes, ib.
Bladder, birds have no bladder for urine, ii. 215. See *Fishes*, iii. 8, &c.
Blennius, or Blenny, description of this fish, iii. 11, 62
Blind, such as live in countries generally covered with snow become blind, i. 239. The mole not blind, ii. 99
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Blood, arterial blood immediately mixed with air in the lungs is of a fine florid scarlet colour; that of the veins returning to the heart is of a blackish crimson hue; whence this difference of colour proceeds, not well understood, i. 142. The blood circulates through the bones, as through every other part of the body; Mr. Belcher the first who discovered it; his experiment to this purpose, 253. Blood of the rein-deer preserved in small casks for sauce with the marrow in spring, 405. The heat of the blood in man and other animals about thirty degrees above congelation; in the marmot and other animals which sleep in winter, it is not above ten degrees, ii. 79
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Bonassus, supposed by Klein and Buffon another name for the bison, i. 342
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Boody, name given by our seamen to birds of the penguin tribe, ii. 404
Borandians, description of them, i. 260
Boristhenes, or Nieper, a river, its course and source, i. 90
Borneo, island in the East Indies, where the babyrouessa, or Indian hog, is principally found; hog of Borneo, the name given by travellers to the babyrouessa, i. 417
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———, of the ancients, supposed of the cow kind by Buffon, placed among the lower class of ruminant quadrupeds, i. 342
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Buck, capable of propagating at the age of one year; one buck sufficient for a hundred and fifty goats; becomes old before his seventh year, i. 358. Hunting the buck and the stag performed in the same manner in England, 383. Number of names invented by hunters for this animal; does not change his lair, like the stag; manner of hunting him is much the same as that of stag-hunting, 330
Buck-goat, produces with the ewe an animal that, in two or three generations, returns to the sheep, retaining no mark of its ancient progenitor, i. 350
Buffalo; of the varieties of the cow kind, but two are really distinct, the cow and the buffalo: they bear an antipathy to each other; they do not breed among each other, and no animals are more distinct, and like each other less; are in abundance in Guinea and Malabar; it is a great swimmer; description of it; the veal of the young is not better eating than the beef of the old; they are natives of the warmer climates, yet are bred in several parts of Europe, particularly in Italy; the female produces one at a time; continues pregnant for twelve months; is afraid of fire; leather made of its hide is well known for thickness, softness, and impenetrability; guided by a ring thrust through its nose; milk of the female not so good as of the cow; two buffaloes yoked draw more than four strong horses: its flesh hard and blackish, disagreeable to taste and smell; this animal wild in many parts of India, and dangerous; manner of hunting them; when tamed, no animal more patient

or humble; inferior in size only to the elephant, the rhinoceros, or hippopotamus; the camelopard, or camel, if taller, neither so long, nor so corpulent; is fond of the water, crosses the largest rivers without difficulty; has an aversion to red colours that resemble flame; in those countries where they are in plenty no person dresses in scarlet; they make most use of their feet in combat, and rather tread their enemies to death than gore them, i. 345

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Buffoon-bird, name our sailors give the Numidian crane; its peculiar gestures and contortions; the French call it Demoiselle; it is a very scarce bird; the ancients have described the buffoon-bird, but not meant the Numidian crane, ii. 363

Bug, the May-bug. See *Beetles*

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Bull-finch, bird of the sparrow kind, ii. 224. May be taught to whistle a regular tune, 346

Bull-head, description of this fish, iii. 63

Bull, the wild in Spain, mean, despicable animal; have nothing of that sternness of aspect remarkable in our bulls, i. 342

Bull's-eye, name given by sailors to a terrible hurricane; described, i. 153

Bunting, bird of the sparrow kind, ii. 334

Burnet, his theory of the earth; a detail of that work, i. 10

Bustard, the largest land-bird that is a native of Britain; inhabits the open and extensive plain; is much larger than the turkey, the male generally weighing from twenty-five to twenty-seven pounds; its description; its food; places where frequently seen in flocks of fifty or more; they have always sentinels placed at proper eminences, ever on the watch to warn the flock of the appearance of danger: are often run down by greyhounds; in what manner; seldom wander above twenty or thirty miles from home; the males have a pouch, holding near seven quarts of water: they change their mates at the season of incubation, about the latter end of summer; separate in pairs, if there be a sufficiency of females for the males; otherwise the males fight until one of them falls; in France, some of those victims of gallantry found dead in the fields; their nests; they lay two eggs, almost the size of a goose-egg; hatch for about five weeks; the young run about as soon as out of the shell; they assemble in flocks in October, and keep together till April: their food in winter; in parts of Switzerland they are found frozen in the fields in severe weather: when taken to a warm place, they again recover; usually live fifteen years, and are incapable of being propagated in a domestic state, ii. 285

Butcher-bird, its description, with its habits; leads a life of continual combat; intrepidity of this little creature, in going to war with the pie, the crow, and the kestril, all above four times bigger than itself; it fights upon the defensive, and often comes to the attack with advantage, particularly when the male and female unite to protect their young, and to drive away the more powerful birds of rapine; in what manner they sally forth against them; sometimes the combat ends with the destruction of the assailant, and also of the defender; the most redoubtable birds of prey respect them, and they fly in their company without fearing their power, or avoiding their resentment; small birds are its usual food; and when it has killed the bird or insect, as asserted by the best authority, it fixes them upon some neighbouring thorn, and when

thus spitted, pulls them to pieces with its bill; the smaller red butcher-bird migrates; the places where they are to be found; their nests, and the number of their eggs; the female feeds her young with caterpillars and other insects, but soon after accustoms them to flesh, procured by the male with great industry; their nature very different from other birds of prey in their parental care, for, instead of driving out their young from the nest to shift for themselves, they keep them with care, and even when adult do not forsake them; the whole brood thus live in a family together; each family afterwards lives apart, and hunt in concert; upon the returning season of courtship this union is at an end, the family parts for ever, each to establish a little household of his own; the manner of flying is always up and down, seldom direct or sideways; different kinds of this bird, ii. 261.

Butter, the fat of the manati serves in all cases instead of butter, ii. 137.

Butterfly, some kinds actually live upon nothing, i. 224. One of the principal ornaments of oriental poetry; in those countries the insect is larger and more beautiful than with us, iii. 249. Easily distinguished from flies of every other kind by their wings; butterflies can discover their mates at more than a mile distant; description of the head, corslet, and body; the eyes have not all the same form; but the outward coat has a lustre, in which may be discovered all the colours of the rainbow; when examined closely, it has the appearance of a multiplying-glass; the use of their horns or feelers as yet unknown; use of their trunks; difference between butterflies and moths; they often perceive the approach of the female at above two miles distance; by what sense is not easy to conceive; it has no organs for smelling; the female is larger than the male; if disturbed while united, the female flies off with the male on her back, entirely passive upon the occasion; after junction, they deposit their eggs and die; all females of this tribe are impregnated by the male by one aperture, and lay their eggs by another; every butterfly chooses for her brood, instead of the plant most grateful in its winged state, that it has fed upon in its reptile form; how they keep their eggs warm, and also entirely concealed; many do not lay till the winter warns them of their approaching end; some continue the whole winter in hollows of trees and do not provide for posterity until the beginning of April, then leave their retreats, deposits their eggs, and die, 272

Buzzard, a sluggish inactive bird, often remains perched whole days upon the same bough; lives more upon frogs, mice, and insects, than upon birds: more troublesome to seize: its manner of living in summer; so little capable of instruction, that it is a proverb to call one obstinately ignorant a buzzard; the honey-buzzard, and the hen-harrier, are of this stupid tribe, and differ chiefly in their size, ii. 261

Byron (Commodore) our last voyager that has seen the gigantic race of mankind, i. 279

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Cabiai, the same animal as the Capibara, i. 415

Cachalot, a fish said to pursue a shoal of herrings, and to swallow thousands at a gulp, iii. 7. It has generally gone under the name of the spermaceti whale, till Mr. Pennant made the distinction, borrowing its name from th French; description; the throat of this animal very formidable; with ease it could swallow an ox: it can at one gulp send a shoal of fishes down its enormous gullet; it terrifies the dolphins and porpoises so much as often to drive them on shore; it contains two precious drugs, spermaceti and ambergris; the oil of this fish is easily convertible into spermaceti, by boiling it with a ley of potash, and hardening it in the manner of soap; candles are now made of it; the balls of ambergris not found in all fishes of this kind, but chiefly in the oldest and strongest, 27

Cagui, or the saki, is the largest monkey of the sagoin kind; its description, ii. 158

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Cairo, in what manner they produce there six or seven thousand chickens at a time, ii. 275
Caius, (Dr.) lived in the time of Queen Elizabeth, wrote the Natural History of Dogs, and divides the whole race into three kinds, the generous, the farm-kind, and the mongrel, ii. 7
Caloa, the horned Indian raven, ii. 300
Calcination, all animal substances, when calcined, are the same, iii. 146
Calf, name given to the young of the hind, or the female of the stag, i. 381
Calf, or hind-calf; the stag called so the first year, i. 383
Callitrix, the green monkey of St. Jago of the ancient continent; its description, ii. 157
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Camel, a ruminating animal, i. 335. Camel and dromedary, not two distinct kinds, only a variety of the same, which has subsisted time immemorial; the only sensible difference between these two races; they produce with each other, and the mixed breed is considered the best; of the two the dromedary is far the most numerous; countries where the camel and dromedary are found; neither can subsist, or propagate, in the climates towards the North; Arabia, the most adapted to the support and production of this animal; the camel the most temperate of all animals; it can continue to travel several days without drinking, and is often six or seven days without any sustenance; its feet formed to travel upon sand, and utterly unfit for moist or marshy places; many vain efforts tried to propagate the camel in Spain; they have been transported into America, but have multiplied in neither; they might perhaps produce in these countries, but would in a few years degenerate; their strength and their patience would forsake them; and, instead of enriching, become a burden to their keepers; uses to which this animal is put among Arabians; its education; it has a fifth stomach, as a reservoir, to hold a greater quantity of water than immediately wanted; when the camel finds itself pressed with thirst, it throws up a quantity of this water, by a simple contraction of the muscles, into the other stomachs; travellers, when straitened for water, have often killed their camels for what they expected to find within them; countries where commerce is carried on by means of camels; trading journey in caravans; their food; pursue their way when the guides are utterly astray; its patience and docility when loaded; in what manner the female receives the male; one male left to wait on ten females, the rest castrated; they live forty or fifty years; every part of this animal converted to some useful purpose; its very excrements are not use less; their burden, ii. 184
Cameleon, its dimensions and appetites; has a power of driving the air it breathes over every part of the body; changes of its colour; it is an error that it assumes the colour of the object it approaches; description of it by Le Brun; it often moves one eye when the other is at rest; sometimes one eye seems to look directly forward, while the other looks backward; and one looks upwards, while the other regards the earth, iii. 161
Camelopard described; dimensions of a young one; inhabits the deserts of Africa; no animal, from its disposition or its formation, less fitted for a state of natural hostility; it lives entirely upon vegetables; known to the ancients, but rarely seen in Europe; often seen tame at Grand Cairo in Egypt; Pomey exhibited at one time ten upon the theatre, ii. 182
Camlet made of the hair of animals about Angora, i. 359
Canada, above thirty thousand martins' skins annually imported from that country into England, ii. 43
Canals for the circulation of blood through the bones; are of different capacities, during the different stages of life, i. 253; canal of communication through which the blood circulates in the fœtus, without going through the lungs, found open in some bodies when dissected, iii. 126
Canary bird taught to pick up the letters of the alphabet at the word of command, to spell any person's name in company, ii 225; by the name originally from the Canary Islands; come to us from Germany, where they are bred in numbers; at what period brought into Europe is not known; about a century ago they

were sold at very high prices, and kept only for the amusement of the great; in its native islands it is of a dusky grey colour, and so different from those seen in Europe, as to raise a doubt about its species; rules and instructions for breeding them in a domestic state; apparatus for breeding it in Germany; food the old ones must be supplied with when the young ones are excluded; so prolific are these birds sometimes, that the female will be ready to hatch a second brood, before the first is able to quit the nest; this bird kept in company with the linnet or goldfinch, pairs, and produces a mixed breed, most like the canary-bird, and resembling it in its song, 343, &c.

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Cancerous breasts cured by the sucking of the rubeth, or the land-toad, iii. 143

Candle quickly extinguished in an exhausted receiver, and why, i. 143

Cannons filled with water, and left to freeze, burst, i. 77

Cantharis, well known in the shops by the name of Spanish flies, and for their use in blisters; their description, with the differences from each other; the countries where, and trees on which they are seen; it is reported, that the country people expect the return of these insects every seven years; their bad smell is a guide to those who catch them; they smell so disagreeable as to be perceived at a great distance, especially about sun-set, though not seen at that time; they yield a deal of volatile caustic salt; their qualities; the effects fall principally upon the urinary passages; in what manner they are killed, iii. 305

Cape de Verde islands, a south wind prevails in them during the month of July, i. 148

Cape of Good Hope, a north-west wind blows there during the month of September, i. 148. Customary to hunt the elephant for its teeth; in what manner; account of an unhappy huntsman, ii. 175

Capibara, or cabiai, an animal resembling a hog of about two years old; its description; some naturalists have called it the water-hog, and why; a native of South America, and chiefly frequenting the borders of lakes and rivers; like the otter it seizes the fish upon which it preys, with its hoofs and teeth: lives also upon fruits, corn, and sugar-canes; its cry resembles the braying of an ass, more than the grunting of a hog; its only place of safety is the water, into which it plunges when pursued, and keeps so long at the bottom, that the hunter can have no hopes of taking it there; when young is easily tamed; its flesh has a fishy taste, but its head is said to be excellent, i. 415

Capon of Pharaoh supposed the true ibis; is a devourer of serpents, and follows the caravans that go to Mecca, to feed upon the offal of the animals killed on the journey, ii. 360

Capons taught to clutch a fresh brood of chickens throughout the year, ii. 275

Caracal, or the syagush, a native of the East Indies, resembles the lynx in size, i. 445

Caraguata, a plant in the West Indies, which clings round the tree it happens to be near; it keeps away that nourishment, designed to feed the trunk, and at last entirely destroys its supporter, i. 176

Carapo, the gymnotus, description of this fish, iii. 64

Carassa, a volcano in South America, i. 44

Caravan, a single lion of the desert often attacks an entire caravan, i. 425. The assemblage called a caravan sometimes composed of numbers amounting to ten thousand, ii. 186

Caracajou, name given by the North Americans to the glutton; its manner of killing the rein-deer, i. 406

Caribou, name the Americans give the rein-deer, i. 406

Carnivorous animals seek their food in gloomy solitude; they are sharper than the ruminating animals, and why; their stomachs small, and their intestines short; their intestines thin and lean, i. 334. Except the dog, none will make a voluntary attack, but with the odds on their side; in proportion as each wants strength, it uses the assistance of patience, assiduity, and cunning; all animals of this kind pursue in a pack, and encourage each other by their

mutual cries; support a state of famine for several weeks together; milk in those animals is more sparing than in others, 302
Carnivorous birds seek for such as are of the size most approaching their own. See *Birds*.
Carp, an experiment made with this fish in a large vase of water, under an air-pump, iii. 8. One found by Buffon not less than a hundred years old; this discovery confirmed by other authors, 10. Continues in the egg not above three weeks, 12. Mr. Tull famous for his invention of spaying carp to give it a fine flavour, 13. Its description, 65. The method of fattening it in a damp cellar; it has been known thus to live for a fortnight, grow exceeding fat, and to get a superior flavour, 67
Carriers, pigeons used to carry letters, ii. 325
Carrion crow resembles the raven in its appetites, its laying and manner of bringing up its young, i. 298
Carthagena, in America; the heat of the climate affects the speech of its inhabitants, which is soft and slow, and their words generally broken; more than three parts of our army destroyed by the climate, in our unsuccessful attack upon it, i. 138
Cartilage, the thyroid cartilage, i. 215. Cartilages in youth elastic, and pliant in age, become at last hard and bony; and why, 253
Cartilaginous fishes, their general conformation; supposed they grow larger every day till they die; their internal structure; are possessed of a twofold power of breathing; apertures by which they breathe; the cartilaginous shark or ray, live some hours after they are taken; fishes of this tribe can remain under water without taking breath; and can venture their heads above the deep, and continue for hours out of their native element; little difference between the viviparous and the oviparous kinds, in this class of fishes; five divisions of the cartilaginous fish, iii. 32
Cassowary, a bird first brought into Europe by the Dutch from Java, in the East Indies, where only it is found; its description; the part which most distinguishes this animal is the head, which inspires some degree of terror; its internal parts described; it has the head of a warrior, the eye of a lion, the defence of a porcupine, and the swiftness of a courser; is not fierce in its natural character; how it defends itself; extraordinary manner of going; the Dutch assert that it can devour glass, iron, and stones, and even live and burning coals, without the smallest fear, or the least injury; the largest of its eggs, is fifteen inches round one way, and twelve the other; places where this animal is found; it has not multiplied in any considerable degree, as a king of Java, made a present of one to the Captain of a Dutch ship, as a rarity, ii. 235
Catacombs of Egypt, i. 286
Catamountain, hunt for the hare or the rabbit, i. 303. The ocelot of M. Buffon; its description, 441. Is one of the fiercest, and, for its size, one of the most destructive animals in the world, 444
Catanea, a city utterly overthrown by an earthquake, i. 149
Cataphracatus, or kabassou, is one of the largest kinds of the armadillo, ii. 114
Cataract of the eye, Mr. Chesselden having couched a boy of thirteen, who to that time had been blind, and at once having restored him to sight, curiously marked the progress of his mind upon the occasion, i. 236
Cataract of the Rhine, and of the Nile, the cataract of the river Velino, in Italy, is above a hundred and fifty feet perpendicular; one near Gottenburgh in Sweden; other cataracts, i. 97
Caterpillars, their differences from all other insects; all these animals are hatched from the eggs of butterflies; during winter the greatest number of caterpillars are in an egg state; in the aurelia state, they are seemingly deprived of life and motion; some do not make any change at the approach of winter, but choose themselves some retreat, and there remain quite motionless, and as insensible as if actually dead; caterpillars of this kind are found in great numbers together, enclosed in one common web that covers them all;

there are some of the kind whose butterflies live all the winter, and where; a single caterpillar eats double its own weight of leaves in a day, and seems no way disordered by the meal; the body of the caterpillar anatomically considered; avidity with which they feed; numbers of their stigmata, or those holes through which the animal is supposed to breathe; it has eighteen lungs; the experiment of Malphigi to ascertain their use; all caterpillars spin at one time or another; many of them change their skins five or six times in a season; and in what manner; change into an aurelia; their retreats in that state, iii. 250. There are thousands of fishes, birds, and insects, that live chiefly upon caterpillars; a single sparrow and its mate, that have young ones, destroy above three thousand caterpillars in a week; some of the kind fitted only to live upon leaves and plants, will eat each other in preference to their vegetable food; the bodies of the larger kinds serve as a nest to various flies, that very carefully deposit their eggs in them; number of worms remain within the body of the caterpillar, devouring its entrails, without destroying its life; the ichneumon tribe is not the caterpillar's offspring, as supposed, but its murderers, 265

Cat-fish, its description, iii. 62

Cats, the wild hunt for the squirrel or the mouse, i. 303. The whole tribe seek their food alone, and never unite for mutual defence, nor for mutual support, and, except at certain seasons are enemies to each other; all of the cat kind devour nothing but flesh, and starve upon any other provision; their greatest force lies in the claws; the cat goes with young fifty-six days, and seldom brings forth above five or six at a time; the male often devours the kittens; before they are a year old they are fit to engender; the female seeks the male with cries; nor is their copulation performed without great pain, and why; cats hunt the serpent in the isle of Cyprus; any animal weaker than themselves, is to them an indiscriminate object of destruction; the mouse is their favourite game, and they patiently watch a whole day, until the mouse appears; a flagrant mark by which the cat discovers its natural malignity; their eyes see better in darkness than light, and why; if the inhabitant quits the house, the cat still remains; is excessively fond of some plants, such as valerian, marum, and cat-mint; particularly loves fish; its sleep is very light; its hair sends forth shining sparks, if rubbed in the dark; the wild breed with the tame; description of the wild cat; inhabits the most mountainous and woody parts, lives mostly in trees, and feeds only by night; the cat was much higher in esteem among our ancestors than it is at present; laws of Howel concerning the price of cats; cats were not naturally bred in our forests; of all quadrupeds the wild cat is, perhaps, that whose intestines are proportionably the smallest and the shortest; and why; common to the new continent, as well as the old; the blue cat; the lion cat, or more properly, the cat of Angora; the cats in Syria and Persia remarkable for their long soft hair, i. 418. All the cat kind are kept off by the fires which the inhabitants light to preserve their herds and flocks; and they hunt rather by the sight than the smell; it happens that the lion pursues the jackall or the wild dog, while they are hunting upon the scent, and merely for themselves; the lion is then an unwelcome intruder upon the fruits of their toil; from thence probably has arisen the story of the lion's provider; the lion devours a great deal at a time, and generally fills himself for two or three days to come; in the deserts and forests, his most usual prey are the gazelles and the monkeys, 428. The race of cats noxious in proportion to their power to do mischief; inhabit the most torrid latitudes of India, Africa, and America, and have never been able to multiply beyond the torrid zone; they seldom attack man, though provoked; of all animals these are the most sullen, and, to a proverb, untameable, 442. Different classes of the kind, from the lion to the cat, 444. The wild cat and the martin seldom meet without a combat; it is not a match for the martin, ii. 42. The cat of Pharaoh injudiciously called the ichneumon, 45. Cats of Constantinople, a name of the genette, and why, 50

Cattle, we have the best breed of horned cattle in Europe; the large hornless breed in some parts of England originaly from Poland, i. 339. The Dutch bring

great quantities of lean cattle from Denmark, to fatten on their own rich grounds; that of the Ukraine becomes fat, and is considered the largest breed of all Europe; in Switzerland these animals grow to a large size; not so in France, 342. Size in Barbary, Ethiopia, Persia, and Tartary, ib. Leather-mouthed cattle, 351. Liable to be destroyed by the South American bat-vampyre, 219

Caverns, the amazing cavern of Elden-hole in Derbyshire; the dreadful cavern in the country of the Arrian Indians, called the Gulf of Pluto, described by Ælian; cavern of Maestricht; its description; no part of the world, has a greater number of artificial caverns than Spain; in general deserted by every race of meaner animals, except the bat; the caverns called Oakley-hole, the Devil's-hole, and Penpark-hole, in England; the cavern of Antiparos, and its discovery, i. 28. How natural caverns formed; two hundred feet as much as the lowest of them is found to sink, 65. One in Africa, near Fez, continually sends forth either smoke or flames, 44

Caviar, the inhabitants of Norway prepare from eggs found in the body of the porpoise, a savoury liquor, which makes a delicate sauce, and is good when eaten with bread, iii. 31. It is made with the roe of the sturgeon; more in request in other countries of Europe than with us; and is a considerable merchandise among the Turks, Greeks, and Venetians; manner of making it, 52

Causes, the investigation of final causes a barren study, and like a virgin dedicated to the deity, brings forth nothing, i. 9

Cayman, a sort of crocodile, iii. 149

Cayopolin, a kind of opossum; its description, ii. 162

Cea, an island washed away with several thousand inhabitants, i. 58

Cenere, a mount of recent appearance, i. 70

Centinel, some animals carefully avoid their enemies, by placing sentries to warn of danger, and know how to punish such as neglect their post, or are unmindful of the common safety, i. 305. When the marmots venture abroad, one is placed as a sentry, upon a lofty rock, ii. 78. The bustards have centinels placed upon proper eminences, where, always on the watch, they warn the flock of the smallest appearance of danger, ii. 286. The flamingo does the same, 372

Centipes, the scolopendra, iii. 222

Centriscus, a kind of cartilaginous fish, iii. 56

Cephus, name given by the ancients to the monkey now called Mona, ii. 157

Cepola, the description of this fish, iii. 62

Cetaceous fishes, the whale and its varieties resemble quadrupeds in their internal structure, and in some of their appetites and affections; they are constrained every two or three minutes to come up to the surface to take breath, as well as to spout out through their nostril (for they have but one) that water which they sucked in while gaping for their prey; the senses of these animals superior to those of other fishes, and it is most likely that all animals of the kind can hear; they never produce above one young, or two at the most; and this the female suckles in the manner of quadrupeds, her breasts being placed as in the human kind above the navel; distinctive marks of this tribe, iii. 14

Chaffinch, a bird of the sparrow kind, iii. 334. Time of emigration of the hen, ii. 221

Chamois, a species of antelope, i. 361. Described, ib.

Charles XII. when shot at the siege of Fredericshall, was seen to clap his hand on the hilt of his sword, i. 258

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favourite spot of the park for pasture, and of driving the vanquished into the more disagreeable parts; manner of their combats; are easily tamed, and browse closer than the stag; they seek the female at the second year; their strength, cunning and courage, inferior to those of the stag; we have in England two varieties of the fallow-deer; one brought from Bengal, the other from Norway; flesh of the French fallow-deer has not the fatness nor the flavour of that fed upon English pasture; Spanish and Virginian fallow-deer; deer without horns, their description, i. 388

Deer (rein) the most extraordinary, and most useful; native of the icy regions of the north; it answers the purposes of a horse; attempts made to accustom it to a more southern climate; in a few months it declines and dies; answers the purpose of a cow in giving milk, and of the sheep in furnishing warm clothing to the people of Lapland and Greenland; description of the rein-deer; its rutting time, and that of shedding its horns; difference between this deer and the stag; it is not known to the natives of Siberia; Americans call it caribou; herdsmen of Lapland known to possess a thousand rein-deer in a single herd; it subsists upon moss, and makes the riches of the people of Lapland; gnats and gad-flies very formidable to this deer in Lapland; female brings forth in May; its milk thinner than that of the cow; sweeter and more nourishing, i. 400. Is of two kinds in Lapland; it draws sledges; can go about thirty miles without halting, and without dangerous effort; generally castrated by the Laplanders; one male left to six females; begin to breed when two years old; go with young eight months, and bring two at a time; fondness of the dam remarkable; live but fifteen or sixteen years; manner in which the Laplanders kill them; scarce any part of this animal not converted to peculiar uses; the Laplanders find their necessities supplied from the rein-deer alone; in what manner; diseases of this animal; the blood of the rein-deer preserved in small casks for sauce with the marrow in spring; the horns converted into glue; the sinews make the strongest sewing-thread; the tongue a great delicacy; the intestines, washed like our tripe, in high esteem among the Laplanders; bears make depredations upon the rein-deer; glutton its most dangerous and successful persecutor; only method of escape from this creature, 406. In what manner the rein-deer is killed by it, ib. The wolf never attacks a rein-deer that is haltered in Lapland, and why, ii. 22

Deformity, children often inherit even the accidental deformities of their parents; instances of it; accidental deformities become natural by assiduity continued and increased through successive generations, i. 270. All those changes the African, the Asiatic, or the American undergo, in their colour, are accidental deformities, probably to be removed, 271

Demoiselle, name given by the French to the Numidian bird, ii. 363

Depona, a large serpent, native of Mexico, iii. 194

Desman, one of the three distinctions of the musk rat; a native of Lapland, ii. 92

Devil (sea) or fishing-frog, described, iii. 54

Dew compensates the want of showers in Egypt, i. 152

Dewlap; of two zebras, seen by the author, the skin hung loose below the jaw upon the neck in a kind of dewlap, i. 333. The cow wants in udder what it has in neck, and the larger the dewlap the smaller the quantity of its milk, 340

Diableret, a mountain in France suddenly fallen down; its ruins covered an extent of a league square, i. 68

Dictionaries of Arts and Sciences, a fault that has infected most of them, i. 298

Diet, of a thin sparing kind, remarkable among quadrupeds as well as the human species, to produce hair, ii. 37

Digester, an instrument; meat and bones put into it, dissolved into a jelly in six or eight minutes, i. 132

Digestion, these organs in birds are in a manner reversed, ii. 215. Not perfect in birds that live upon mice, lizards, or such like food, 266. Performed by some unknown principle in the stomach, acting in a manner different from all

kinds of artificial maceration; this animal power lodged in the maw of fishes, iii. 6

Disorders, infectious, propagated by the effluvia from diseased bodies, i. 138. Most of those incident to mankind, says Bacon, arise from the changes of the atmosphere, iii. 10. Fishes have their disorders, 79

Diver (the great northern), a bird of the smaller tribe of the penguin kind; the grey speckled diver, the scarlet-throated diver, ii. 405

Divers known to descend from twenty to thirty fathom; of all those who have brought information from the bottom of the deep, Nicolo Pesce the most celebrated; account of his performances by Kircher, i. 127. Some known to continue three quarters of an hour under water without breathing; they usually die consumptive; manner of fishing for pearls, iii. 125

Dodo, its description; among birds, as the sloth among quadrupeds, an unresisting animal, equally incapable of flight or defence; natives of the Isle of France; the Dutch first discovered and called it the nauseous bird; travellers deem its flesh good and wholesome; it is easily taken; three or four dodos enough to dine a hundred men; whether the dodo be the same bird with that described under the name of the bird of Nazareth remains uncertain, ii. 238

Doe, the female of the deer kind, i. 390

Dogs, always running with their noses to the ground, supposed of old the first that felt infection, i. 137. In the dog kind the chief power lies in the under jaw, i. 419. In Syria, remarkable for the fine glossy length and softness of their hair, 424. In tropical climates lose the delicacy of their scent, and why; the lion, tiger, panther, and ounce, all natural enemies to the dog, 444. Dog kind not so solitary as those of the cat, ii. 1. Their proper prey are animals unfitted for climbing; they can live for some time upon fruits and vegetables, 2. Description of the dog; knows a beggar by his clothes, by his voice, or his gestures, and forbids his approach, ib. The dog most susceptible of change in its form, 4. All dogs are of one kind; which the original of all; which the savage dog; whence such a variety of descendants is no easy matter to determine; the shepherd's the primitive animal of his kind; those wild in America and Congo, as those of Siberia, Lapland, Iceland, of the Cape of Good Hope, of Madagascar, Calicut, and Malabar, resemble the shepherd's dog; those in Guinea, at the second or third generation, forget to bark; dogs of Albany, of Greece, of Denmark, and of Ireland, larger and stronger than any other; shepherd's dog, transported into temperate climates, and among people entirely civilized, from influence of climate and food alone, become a matin, a mastiff, or a hound; *Turkish dog; great Danish dog; great Irish Wolf dog; the little Danish dog;* their variety now in England much greater than in the time of queen Elizabeth; Dr. Caius divides the whole race into three kinds, the generous, the farm kind, the mongrel, 5, &c. Three shepherd's dogs reckoned a match for a bear, and four for a lion; three of them overcame a lion in the time of King James the First; the famous poet, Lord Surrey, the first who taught dogs to set; the *pug dog;* the English *bull dog;* the *lion dog;* originally from Malta; its description; the *Molossian dogs* of the ancients, according to M. Buffon; *Epirotic dogs,* mentioned by Pliny; *Indian dogs,* mentioned by Ælian; his description of a combat between a dog and a lion; the bravest of the kind; the nobler kind of dogs, of which such beautiful ancient descriptions, now utterly unknown; puppies' eyes not open till ten or twelve days old; dog's teeth amount to forty-two; this animal capable of re-producing at the age of twelve months; goes nine weeks with young, and lives about twelve years; other particulars concerning dogs; many kinds of birds the dog will not touch; dogs and vultures living wild about Grand Cairo in Egypt, continue together in an amicable manner, and are known to bring up their young in the same nest; dogs bear hunger for a long time; a bitch, forgotten in a country house, lived forty days without any other sustenance than the wool of a quilt she had torn in pieces, 14. The wild, hunt in packs; unknown, such as he was before the production of man; some from a domestic state, have turned savage, and partake of the disposition of the wolf, and attack the

most formidable animal of the forest; are easily tamed, and quickly become familiar and submissive, 3. Experiments to prove the wolf and the fox not of the same nature with the dog, but of a species perfectly distinct; animals in this country bred between a dog and a fox, 12. A dog set at liberty, in his savage fury flew upon every animal, owls, sows, and men, 13. The dog and wolf so much alike internally, that anatomists can scarce perceive the difference; a young dog shudders at the sight of a wolf; dogs and wolves so different in their dispositions, that no animal can have a more perfect antipathy, 16. By instinct, without education, dogs take care of flocks and herds; show no appetite to enjoy their victory when the wolf is killed, but leave him where he falls, 17. Catesby asserts the wolf was the only dog used by the Americans before the Europeans came among them, and that they have since crocreated together; thus proving the dog and the wolf of the same species, 22. Insurmountable antipathy between the dog and the jackall; they never part without an engagement, 29. Famished dogs more hairy than those whose food has been more plentiful, 37. All kinds pursue the hare by instinct, and follow it more eagerly than other animals, 60. Few dogs dare to encounter the otter, 123. Some purposely trained for discovering the retreat of the otter, ib.

Dog butchers all over China, and shambles for selling their flesh; wherever a dog butcher appears, all the dogs of the place are in full cry after him; along the coasts of Guinea, their flesh is esteemed a delicacy by the Negroes; they give a cow for a dog, ii. 12

Dolphin, caught in the Red Sea, known by a ring to be the same taken before in the Mediterranean, i. 114. Allured by music, 242. Not easy to assign a cause why the ancients have invented so many fables on the subject; their boundings in the water have taught mariners to prepare for a storm; old painters and sculptors have drawn them wrong; Rondelet assures us he has seen a dolphin carried alive from Montpellier to Lyons; their motions the gambols of pleasure, or the agitations of terror, not well known; in fair weather they herd together, and pursue shoals of various fish with impetuosity, iii. 39

Dolphin is also the name of the ophidium, or the gilt-head, iii. 61

Dorado, a fish of the spinous kind, the most voracious; its description; the flying-fish is chiefly sought by it; warfare carried on between them, iii. 76

Doree, description of this fish, iii. 63

Dormouse, the mercury of the thermometer plunged into the body of the living dormouse, never rose beyond its pitch in air, and sometimes sunk above a degree, ii. 79. The greater sort M. Buffon calls the *loir*, the middle size he calls the *lerot*, and the less he denominates the *muscardin*; their descriptions; agree in being stupified like the marmot during winter; their nests and provisions; they bring forth three or four young at a time but once a-year, in the spring, 91

Dorr-beetle, or May-bug, iii. 300. See *Beetle*

Dottrel, a small bird of the crane kind, ii. 376

Doves, the *ring-dove*, ii. 326. The *turtle-doves*, 326. The *stock-dove*, 323. See Pigeon.

Doue, a monkey of the ancient continent, so called in Cochinchina, where it is a native; its description; forms part of the chain by which the monkeys of one continent are linked with those of the other, ii. 157

Draco-volans, a flying ball of fire, i. 161

Drag, name given by the huntsmen to the tail of the fox, ii. 25

Dragons, the whole race dwindled down to the flying lizard, iii. 164

Dragon-fly, or the libella, described, iii. 227

Dragonet, a description of this fish, iii. 62

Drill of Purchas, an ape of the ourang-outang kind, ii. 139

Dromedary, a sort of camel, ii. 184

Drones, the second sort of bees, supposed to be the males; their cells; the

working bees kill the drones in the worm state in the cell, and eject them from the hive, among the general carnage, iii. 273, &c.

Dryness a great degree of it produced by heat, preserves from corruption, i. 285

Duck, when ducks are caught, the men keep a piece of turf burning near their mouths, and breathe upon it, lest the fowl, smelling them, should escape, ii. 213. Plutarch assures us, Cato kept his family in health, feeding them with duck, whenever they threatened to be out of order, 109. Its eggs often laid under a hen; seems a heedless, inattentive mother; of the tame duck, ten different sorts; and of the wild, Brisson reckons above twenty; the most obvious distinction between the wild and tame ducks; difference between wild ducks among each other; sea and pond ducks; names of the most common birds of the duck kind among ourselves; and of the most noted of the foreign tribe; their habits, nests, and number of eggs; are, in general, birds of passage; their flesh; the ducks flying in the air, often lured down from their heights by the loud voice of the mallard from below; what part of the lake they generally choose; what can employ them all day not easy to guess; manner of making and managing a decoy to take them; the American wood-duck; general season for catching them in decoys, from the end of October till February; taking them earlier prohibited by an Act of George the Second, imposing a penalty of five shillings for every bird destroyed at any other season; amazing quantity of ducks sent to supply the market of London; manner of taking them frequently practised in China, 420, &c.

Dunlin, a small bird of the crane kind, ii. 376

Dwarf, in England, as late as the time of King James the First, the court was furnished with one; and he was called little Jeffery; Peter of Russia celebrated a marriage of dwarfs, i. 275. They seem to have faculties resembling those of children; history of a dwarf accurately related by M. Daubenton, 277

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Eagle kind, the flap of an eagle's wing known to lay a man dead in an instant, ii. 212. It flies at the bustard or the pheasant, 240. Distinctive marks from the other kinds of carnivorous birds, 242. The golden eagle is the largest and noblest of all those birds designated by the name of eagle; its description; considered among birds as the lion among quadrupeds; strong similitude to each other; great patience, and much art, required to tame an eagle; though taken young, and brought under by long assiduity, yet it is a dangerous domestic, and often turns its force against its master; sometimes has an attachment for its feeder; it is then serviceable, and will provide for his pleasures and support; flies the highest of all birds, and from thence has by the ancients been called the bird of Heaven; it has also the quickest eye, but its sense of smelling is far inferior to that of the vulture; it never pursues but in sight; finds difficulty in rising when down; carries away geese, cranes, hares, lambs, and kids, and often destroys fawns and calves, to drink their blood, and carries a part of their flesh to its retreat; infants, when left unattended, have been destroyed by these rapacious creatures; the eagle is peculiarly formidable when bringing up its young; a poor man got a comfortable subsistence for his family, during a summer of famine, out of an eagle's nest, by robbing the eaglets of food; eagles killed a peasant who had robbed their nests; there is a law in the Orkney Islands, which entitles any person that kills an eagle to a hen out of every house in the parish in which the plunderer is killed; the nest of the eagle is usually built in the most inaccessible cliffs of the rock; description of one found in the Peak of Derbyshire; it hatches its eggs for thirty days; very rare to find three eaglets in the same nest; and it is asserted, that the mother kills the most feeble or the most voracious; it is believed they live above a hundred years, and that they die, not of old age, but from the beaks turning inward upon the

under jaw, and preventing their taking any food; an eagle endured hunger for twenty-one days, without any sustenance whatever; they are first white, then inclining to yellow, and at last light-brown; age, hunger, captivity, and diseases, make them whiter; those kept tame are fed with every kind of flesh, fresh or corrupting; and upon a deficiency of that, bread, or any other provision, will suffice; it is dangerous approaching them, if not quite tame; and they sometimes send forth a loud, piercing, lamentable cry, which renders them still more formidable; they drink put seldom, and perhaps when at liberty, not at all; the bald eagle an inhabitant of North Carolina; breeds in that country all the year round; manner in which the eggs are hatched; characteristics and habitudes of this animal; its nest is large enough to fill the body of a cart, and commonly full of bones half eaten, and putrid flesh, the stench of which is intolerable, ii. 242, &c.

Eagle, the *sea eagle* called *aquila piombina* by the Italians; they often lay three or four eggs, of a less size than those of a hen; of a white eliptical form; distinctive marks of the *golden eagle*, of the *common eagle*, of the *bald eagle*, of the *white eagle*, of the *rough-footed eagle*, of the *white-tailed eagle*, of the *erne*, of the *black eagle*, of the *sea eagle*, of the *osprey*, of the *jean le blanc*, of the *Brasil eagle*, of the *Orooboko eagle*, of the *crowned African eagle*, of the *eagle* of *Pondicherry*, ii. 246.

Ears, distinguishing features in quadrupeds; serve in them as principal marks of the passions; smallest ears in men said to be most beautiful; the largest the best for hearing; some savage nations bore their ears, and draw that part down till the tip of the ears rests upon the shoulder, i. 212. Undulations, which strike the ear, supposed but one continued sound, by their quick successions, though in reality they make many, i. 240. Persons hear differently with one ear from the other; these have what musicians call a bad ear; and, as hearing false, also sing false; such persons also deceived as to the side whence the sound comes, 244. From what cause the small ears of the Tartars and Chinese, 270. Those of the hare moveable and capable of direction to every quarter, ii. 59. Birds have not the external ear standing out from the head; probably the feathers encompassing the ear-holes supply the defect of the exterior ear, 213

Earth, its globe a million of times less than the sun, i. 1. Placed at a happy middle distance from the centre in our solar system; less distant from the sun than Saturn, Jupiter, and Mars, and less parched up than Venus and Mrecury situated too near the violence of its power; the earth, like a chariot wheels, has a compound motion; its rotundity proved; is rather flatted at the poles, and its form resembles that of a turnip, 4. Considered as one scene of extensive desolation, 9. Supposed by Buffon a globe of glass; by Whiston a sphere of heated iron; by Kircher one dreadful volcano; by Burnet a great mass of water; composed of different layers or beds, lying horizontally one over the other, like the leaves of a book, 24. By Hutton supposed to have existed from eternity, and that there is no trace of beginning or end, 16. By Whitehurst to have originated from a fluid state, and gradually become solid, 18

Earth, garden, or mould earth, a kind of mother never found an enemy to man, i. 25. Black earth formed by decayed leaves and branches in Burgundy, 26. Drying and astringent earth preserves bodies from corruption, 282. All such earths as ferment with vinegar are a composition of shells, decayed and crumbled down to one uniform mass, iii. 108

Earthquakes frequent through the whole region where a volcano is situated, i. 39. Various kinds of them distinguished by philosophers, and by M. Buffon; air the only active operator in them; several opinions upon the cause of them; activity of internal heat alone sufficient to account for every appearance attending earthquakes; twelve cities in Asia Minor swallowed up in one night; extraordinary earthquake related by Pliny; account of that in the year 1693, extending to a circumference of two thousand six hundred leagues; minute

description of that in Jamaica in 1692; account of the dreadful shock in Calabria in 1638; concomitant circumstances attending earthquakes, 52
Earth-worm of America, often a yard in length, and thick as a walking cane, i. 177. Its description, iii. 314
Earwig, its habits; reproaches groundless about this animal; its food; general characteristics of the kind; lives in its winged state a few days; dies to all appearance consumptive, iii. 243
Echeneis, the sucking fish, its description, iii. 64
Echini, or Urchins, a multivalve shell-fish, iii. 127. See *Urchins*.
Echo, no art can make an echo, i. 244
Eel described, iii. 64
Effluvia from diseased bodies propagate disorders called infectious, i. 140
Egg, all birds, most fishes, and many of the insect tribes, brought forth from eggs, i. 185. Warmth of the sun, or of a stove, efficacious in bringing the animal in the egg to perfection; its description; history of the chicken in the egg to its complete formation, 186. The ichneumon discovers and destroys the eggs of the crocodile; the crocodile lays in the sand at a time three or four hundred, ii. 46. Such birds as undisturbed lay but two or three eggs, when their eggs are stolen lay ten or twelve; a common hen, moderately fed, lays above a hundred from the beginning of spring to the latter end of autumn, ii. 220. Some of the ostrich weigh above fifteen pounds, 231. Inhabitants of Norway prepare from the eggs of the porpoise a kind of caviar, or delicate sauce, good when eaten with bread, iii. 31. Manner in which the eggs of fishes are impregnated wholly unknown, 74. Doubts whether fish come from the egg completely formed, ib. Those of the turtle hatched by the sun, 100
Eggs, (sea) name given in our cabinets to a multivalve shell-fish, called echini, or urchins, by naturalists; those of the sea urchin a great delicacy, iii. 127.
Egypt has south winds so hot during summer that respiration is almost stopped by them; they are charged with such quantities of sand, that they darken the air as with a cloud; it rains very seldom in that country, but the want of showers is compensated by the copiousness of their dews, i. 152. A mummy not long since dug up in France, shows the art of embalming more completely understood in the western world than in Egypt itself, 289. The ichneumon used in this kingdom for the same purposes that cats are in Europe, ii. 45.
Egyptians carried the art of embalming to the highest perfection; copious detail of it, i. 286. Paid divine honours to the ibis; Maillet's observations concerning this bird, ii. 360
Eider-duck, ii. 416. Remarkable for the warmth of its nest, ib. Furnishes the valuable luxury called *either down*, 420
Elephant, not afraid singly to make opposition to the lion, i. 429. Not less remarkable for its size than its docility; all historians concur in giving it the character of the most sagacious animal next to man; its height from seven to fifteen feet; impossible to give an idea of this animal's figure by description; assisted by the art of the engraver it will but confusedly represent the original; general observations about its conformation; of all quadrupeds the elephant the strongest and largest, yet neither fierce nor formidable; in its native deserts seldom alone, being a social friendly creature; the oldest conducts the band, the next in seniority brings up the rear; order maintained in dangerous marches; never so far asunder as to be incapable of reciprocal assistance; their invasions the more disagreeable, there being no means of repelling them, since an attempt to molest a drove would certainly be fatal; manner of going against him who offers the insult; do no personal injury when suffered to feed uninterrupted; molested by man, they seek all occasions to be revenged; where they like best to live in their natural state; cannot live far from water, and always disturb it before they drink; often fill their trunk with water to cool it, or by way of play to spurt it out like a fountain; equally distressed by the extremes of heat and cold; swim from the continent into islands some

leagues distance; frequently migrate from one country to another, and why; their food of the vegetable kind, loathing all sort of animal diet; one finding a spot of good pasture invites the rest to partake of it; precautions by Negroes and Indians against them; they often break through their fences, destroy the harvest, overturn their habitations, and then retreat in order as they made the irruption; looks with attention and friendship at its master; its ears wipe its eyes and cover them against the dust and flies; it likes music, learns to beat time, move in measure, and join its voice to the sound of the drum and trumpet; is pleased with the odours that delight man; the orange-flower particularly grateful to its taste and smell; pick up flowers, and is pleased with the scent; seeks the most odoriferous plants for food; prefers the cocoa, the banana, the palm, and the sago tree to all others; eats plants to the roots; their sense of touching most delicate; description of its trunk; serving all the purposes of a hand; breathes, drinks, and smells through the trunk; takes a pin from the ground, unties knots of a rope, unlocks a door, and writes with a pen, ii. 167. An object too large for the trunk to grasp is sucked up by its breath, lifted, and sustained; the trunk its organ of smelling, touching, of suction, of ornament, and defence; its neck so short that it must turn about to discover what is behind it; how the hunters escape its resentment; a description of its legs; while young it bends the legs, but when old or sickly it wants human assistance, and chooses to sleep standing; a description of its feet and of its tusks; these with age become so heavy, that it is obliged to rest them in holes in the walls of its stall; they are two; their amazing size; they proceed from the upper jaw, not from the frontal bones, and are not horns as some have supposed, nor ever shed in a domestic state; Ælian saw an elephant writing Latin characters on a board, his keeper only shewing him the figure of each letter; extraordinary manner of eating; is not a ruminating animal; its stomach and intestines resemble those of a horse; opinion that the young elephant sucks with its trunk, not with its mouth, referred to future discoverers; the skin not covered with hair, a few bristles in the scars and wrinkles of the body, and thinly scattered over the skin; the hide resembles the bark of an old tree, more than the skin of an animal; is subject to that disorder known by the name of elephantiasis, or Arabian leprosy; in what manner the Indians endeavour to prevent it; the flies torment this animal incessantly; what arts it tries to keep them off; in a state of nature, it rarely quits the river, and often stands in water up to the belly; from time immemorial employed for the purposes of labour, of war, to increase the grandeur of the eastern princes, or to extend their dominions. Is a native of Africa and Asia; still retains its natural liberty in Africa; during the splendour of the Carthaginian empire, they were used in the wars; no elephants found on this side Mount Atlas; places where they are in great numbers; the greatest elephants found in Asia; their price increases in proportion to their size; the largest kept for princes; their colour; that appropriated for the monarch's own riding kept in a palace, attended by nobles, and almost adored by the people; opinions concerning the white elephant; the eastern princes maintain as many elephants as they are able, and place great confidence on their assistance in an engagement; they never breed in a state of servitude, and the generative powers fail when it comes under the dominion of man; duration of pregnancy in the female still a secret; what Aristotle and others say concerning this and their young is doubtful; method of taking them wild in the wood; Negroes of Africa, who hunt this animal for its flesh, take it in pit-falls; its attachment to the person that attends it; it comprehends several of the signs made to it, distinguishes the tone of command from that of anger or approbation, and acts accordingly; executing orders with prudence, eagerly, yet without precipitation; is taught to kneel down, to receive its rider, usually mounted upon its neck; caresses those it knows, salutes such as it is ordered to distinguish, and helps to take up its load; takes a pleasure in the finery of its trappings; draws chariots, cannon, or shipping with strength, and perseverance, and satisfaction, provided it be not corrected without a cause, and that its master

be pleased with its exertions; in what manner the conductor guides it; frequently takes such an affection to its keeper, as to obey no other; has been known to die of grief for killing his conductor in a fit of madness; surprising instance of moderation in its fury; a word sufficient to put it in motion. A century or two ago, the Indian generals placed great dependence upon the number and the expertness of their elephants; of late they are little used, except for drawing cannon, and transporting provisions; still they are used in war in Siam, in Cochin-China, in Tonquin and Pegu; in what manner armed and led to battle; effects of its fury in the field; those placed upon its back in a square tower, combat as from an eminence, and fling down their weapons with double force; nothing more dreadful, or more irresistible, than such moving machines to men unacquainted with the modern arts of war; Romans quickly learned the art of opening their ranks to admit the elephant, and separating it from assistance, compelled its conductors to calm the animal's fury, and to submit; sometimes, instead of obeying, turned upon those it was employed to assist; one elephant is known to consume as much as forty men in a day; they are now chiefly employed in carrying or drawing burthroughout the peninsula of India; it can, with ease, draw more than six dens, horses can remove; it carries upon its back three or four thousand weight; and upon its tusks it can support near a thousand; when pushed, it moves as swiftly as a horse at full gallop; it travels fifty or sixty miles a-day; and, hard pressed, almost double that number; hard trotting on at a great distance; its track is deeply impressed on the ground, and from fifteen to eighteen inches in diameter; used in India as executioners, and with what dexterity they perform the horrid task; sometimes they impale the criminal on their enormous tusks; two surprising instances how sensible it is of neglect; the keeper despising its endeavours in launching a ship, the animal redoubled its efforts, fractured its skull, and died upon the spot; revenge of one of them took upon a tailor who pricked its trunk with a needle at Delhi; is mindful of benefits; instances of it; at the Cape of Good Hope they are hunted for the sake of their teeth; in what manner; account of an unhappy huntsman; teeth of the elephant found in a fossil state; two great grinding teeth, and part of the tusk of an elephant, discovered at the depth of forty-two yards, in a lead mine in Flintshire. Tusks of the elephant that come from Africa seldom exceed two hundred and fifty pounds, 175

Elephantiasis, or the Arabian leprosy, a disease to which man and the elephant are equally subject; in what manner the Indians endeavour to prevent it, ii. 169

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Elk, its size equal to that of the elephant; is an animal rather of the buck than the stag kind; known in America by the name of moose-deer; is sometimes taken in the German and Russian forests; but extremely common in North America; its horns fortuitously dug up in many parts of Ireland, measuring ten feet nine inches from tip to tip; a small one the size of a horse, and the horns little larger than those of a common stag; Jocelin and Dudley describe this animal about eleven feet high; others extend their accounts to twelve and fourteen feet; never disturbs any other animal, when supplied itself; a female of this kind shown at Paris in the year 1742; its description; they gave it thirty pounds of bread every day, besides hay, and it drank eight buckets of water, i. 395

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obstinately, and the stronger destroys the weaker; no natural instinct; the female sees her young destroyed, without attempting to protect them; suffer themselves to be devoured by cats; fed upon recent vegetables they seldom drink; sometimes gnaw clothes, paper, or other things of the kind; drink by lapping; confined in a room seldom cross the floor, but keep along the wall; never move abreast together; chiefly seeks the most intricate retreats, and venture out only when all interruption is removed, like the rabbits; in cold weather more active; a very cleanly animal; their place must be regularly cleaned, and a new bed of hay provided for them once a-week; the young falling into the dirt, or otherways discomposed, the female takes an aversion to them, and never permits them to visit her more; her employment, and that of the males, consists in smoothing their skins, disposing their hair, and improving its gloss, and take this office by turns; do the same to their young, and bite them when refractory; reared without artificial heat; no keeping them from fire in winter, if once permitted to approach it; manner of sleeping, the male and the female watch one another by turns; generally capable of coupling at six weeks old; time of their gestation; the female brings forth from three to five at a time, not without pain; suckles her young about twelve or fifteen days, and suffers the young of others, though older, to drain her, to the disadvantage of her own; produced with eyes open, and in twelve hours equal to the dam in agility; capable of feeding upon vegetables from the beginning; their disputes for the warmest place, or most agreeable food; manner of fighting; flesh indifferent food; difficultly tamed; suffer no approaches but of the person who breeds them; manner of eating; drink seldom and make water often; grunt like a young pig; appear to chew the cud, ii. 83

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like other parts of the body; takes colour from the juices flowing through it; each, viewed with a microscope, consists of five or six lesser, wrapped up in one common covering, and sends forth branches at the joints, suitable to the size or shape of the pore through which it issues; bulbous at the root, and its end resembles a brush; length and strength of hair a mark of a good constitution; Americans and the Asiatics have it thick, black, straight, and shining; inhabitants of the torrid climates of Africa, have it black, short, and woolly; the people of Scandinavia have it red, long, and curled; opinion that every man has dispositions resembling those of the inhabitants of countries he resembles in the colour and nature of his hair; curled hair among us a beauty; the Greeks have taken one of their national distinctions from the length and straightness of the hair; Americans take the greatest pains in cutting their hair; variety in customs and manner of cutting hair, 209. Trade of the inhabitants of Angora with the hair of animals of their country; camblet and other stuffs made of it, 359. Hair of the cat rubbed in the dark sends forth shining sparks, 422. Syria and Persia noted for long soft hair of the animals bred in them, 424. Each hair of the lynx is of three different colours, 442. Of the black fox, so disposed as impossible to tell which way the grain lies, ii. 27. Coats of hair seem to thicken at the approach of winter; among quadrupeds as among men, thin spare diet produces hair, 36. On the soles of the feet, and on the insides of the mouths of hares, ii. 61.

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seven or eight years, and come to perfection in one year; females live longer; M. Buffon makes a doubt of it; seldom heard to cry, except when seized or wounded; their cry nearly like the squalling of a child; are easily tamed; though never so young, regain their native freedom at the first opportunity; have a good ear, and been taught to beat the drum, dance to measure, and go through manual exercise; make themselves a form where the colour of the grass resembles that of their skin, open to the south in winter, and to the north in summer; sore hunted, will start a fresh hare, and squat in its form; some enter holes like the rabbit, by hunters termed going to vault; as it tires, treads heavier, and its scent is stronger; young hares tread heavier than old; male makes doublings of greater compass than the female; divided by hunters into mountain and measled hares; mode of expression, 'the more you hunt, the more hares you shall have,' and why; what animals persecute the hare; its enemies so various, that it seldom reaches the short term limited by nature; in countries near the North Pole, they become white, and are often in great troops of four or five hundred; their skins sold for less than seven shilings a hundred; the fur known to form a considerable article in the hat manufacture; found also entirely black in much less quantity than the former; some have been seen with horns, but rarely; those in hot countries smaller than ours; those in the Milanese the best in Europe; scarce a country where not found, from the torrid zone to the polar circle; natives of Guinea kill numbers at a time; in what manner; the Jews, ancient Britons, and Mahometans, all considered it as an unclean animal, and religiously abstained from it; hare and rabbit distinct kinds; refuse to mix with each other; an instance; laws made for the preservation of them, ii. 58, &c.

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attachment to their feeder, and docility the baser race are strangers to; names of hawks of the baser race; those of the generous breed remarkable for courage, swiftness, and docility in obeying the commands and the signs of their master; account of the manner of training a hawk; falconers had a language peculiar, in which they conversed and wrote, 255, &c.

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hog, or the mastiff; marching before the little troop, by a variety of notes, calling her train to their food, or warns them of danger; instances of the brood running for security into a hedge, while the hen stood boldly forth, and faced a fox that came for plunder; artificial method of hatching chickens in stoves, practised at Grand Cairo, or in a laboratory with graduated heat, effected with woollen hens, by M. Reaumur; by these contrivances, from a hen naturally producing twelve chickens in the year, are obtained artificially above two hundred, 273. Common hen supplies the place of the hen pheasant, when refusing to hatch her eggs, and performs the task with perseverance and success, 283

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Mole, no quadruped fatter, none with a more sleek, glossy skin; an utter stranger in Ireland; formed to live under the earth; its description; the ancients, and some moderns, of opinion that the mole was blind, but Derham, by a microscope, discovered all the parts of the eye known in other animals; a mole let loose in the midst of a field, like a ghost on a theatre, instantly sinks into the earth, and an active labourer, with a spade, pursues it in vain; peculiar advantage of the smallness of its eyes; when once buried in the earth, it seldom stirs out; it chooses the loser, softer grounds; chiefly preys upon worms and insects; is most active, and casts up most earth immediately before rain, and in winter before a thaw; in dry weather, it seldom forms hillocks; readily evades the pursuit of animals stronger and swifter than itself; its greatest calamity is an inundation; in some places considered by the farmer as his greatest pest; couples towards spring, and the young found about the beginning of May; generally four to five at a time; description of the mole-hill, in which the female has brought forth her young; is scarcely found,

except in cultivated countries; the varieties are but few; that of Virginia is black, mixed with a deep purple; that of Poland is white; Agricola says he saw hats made of mole-skins, the finest and most beautiful imaginable, ii. 97

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Monkey, they sometimes fall a prey to the lion in deserts and forests, i. 428 One general description will not serve for all the animals of the monkey kind, ii. 238. La Condamine asserts it would take up a volume to describe the differences of monkeys found along the river of Amazons; and we are sure that every one of these is different from those on the African coast; an elaborate description of each must be useless and tiresome, their numbers being very great, and their differences very trifling; those of two cantons never found to mix; of all kinds, less than the baboon, have less power of doing mischief, and their ferocity diminishes with their size; do nothing desired without beating; their fears once removed, they are the most insolent, headstrong animals in nature; in their native woods, are the pests of other animals, and the masters of the forest where they reside; the tiger or the lion will not venture to dispute dominion with creatures, who, from the tops of trees, with impunity carry on an offensive war, and by their agility escape all pursuit; birds have not less to fear from their continual depredations, such being their petulant delight in mischief, that they fling the eggs against the ground, when wanting appetite to devour them; one only animal in the forest ventures to oppose them, that is the serpent; larger snakes often wind up the trees where they reside, and happening to surprise them sleeping, swallow them whole, before they can make defence; they generally inhabit the tops of trees, and the snakes cling to the branches nearer the bottom; in this manner they are near each other, like enemies in the same field of battle; some supposed their vicinity rather argued mutual friendship, 150, &c. Father Labat has seen them playing their gambols upon those branches on which the snakes were reposing, and jumping over them without receiving any injury; they provoke the snake, as the sparrows twitter at a cat; when attacked, they show perfect skill in defending and assisting each other; they regularly begin hostilities against those who enter their woods; they take most desperate leaps, and seldom come to the ground; one being wounded, the rest come round, put their fingers into the wound, as desirous of sounding its depth; the blood flowing in any quantity, some stop it, while others get leaves, chew, and thrust them into the opening; are often killed in numbers before they make a retreat, with the same precipitation as they at first came on; in this retreat the young are clinging to the back of the female, who jumps away, seemingly unembarrassed by the burden; usual way of taking them alive; the monkey, not killed outright, does not fall; but, clinging to some branch, continues, when dead, its last grasp, and remains where shot until it drops by putrefection; skinned and served up at negro feasts, so like a child, an European is shocked at the sight; the negroes seeing Europeans buy young and tame monkeys, with equal care brought rats to the factors for sale, and were greatly disappointed at finding no purchaser; negroes cannot comprehend advantages arising from educating or keeping animals, who come in companies to lay waste fields of corn or rice, or plantations of sugar-canes; they carry off what they are able, and destroy ten times more; manner of their plundering; are under a kind of discipline, exercised among themselves; account to this purpose by Margrave; one species, by M. Buffon called the ouarine, remarkable for loudness and distinctness of voice; use to which they convert it; are generally together in companies, march in exact order, and obey the voice of some chieftain, remarkable for his size and gravity; chief food of the tribe; extraordinary manner of managing

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Monkey-bezoar, a factitious concrete, i. 367. See *Bezoar*.

Monoculus, the arborescent water-flea, its description; are of a blood-red colour, and sometimes in such multitudes on standing waters, as to make them appear all over red, whence the water has been thought turned into blood; its branching arms, and the motion made with them in the water, deserve great attention, iii. 217

Monsoon so called from a famous pilot of that name, who first used them in navigation with success; in the ocean between Africa and India, those of the east winds begin in January, and end at the commencement of June; in August or September the contrary takes place, and the west-winds blow for three or four months, i. 148. Monsoons prevail at different seasons throughout the Indies, 153

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Moose-deer, name in America for the elk; its description, i. 395

Mormyrus, description of this fish, iii. 65

Moron, a kind of salamander, thought venomous, iii. 155

Morse, an animal of the seal kind, might be ranked among fishes, i. 300. Generally frequents the same places where seals reside; different from the rest in a very particular formation of the teeth; resembles a seal, except that it is much larger; are rarely found but in the frozen regions near the Pole; formerly more numerous than at present; the Greenlanders destroyed them more before those as were visited by European ships upon the whale fishery, than now; its teeth generally from two to three feet long; the ivory more esteemed than that of the elephant; the fishers have formerly killed three or four hundred morses at once; their bones are still lying in prodigious quantities along those shores they chiefly frequented, ii. 134

Moschitoes, excessive torments caused by them; houses forsaken on their account, i. 64

Moss, the only support of the rein-deer in Lapland; of two sorts, white and black, i. 400

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Mouse, the most feeble and most timid of all quadrupeds, except the Guinea-pig; never rendered quite familiar; though fed in a cage, retains its apprehensions; no animal has more enemies, and few so incapable of resistance; the owl, cat, snake, hawk, weasel, and rat, destroy them by millions; brings forth at all seasons, and several times in the year; its usual number from six to ten; these in a fortnight strong enough to shift for themselves; places where chiefly found; Aristotle, having put a mouse with young into a vessel of corn, some time after found a hundred and twenty sprung from that original; its life last two or three years; the species found in all parts of the ancient continent, and has been exported to the new; Gesner minutely describes the variety of mouse-traps; long-tailed field-mouse; short tailed field-mouse; has a store against winter, a bushel at a time; a description of the shrew-mouse, ii. 90.

Moustoc, or Whitenose, monkey of the ancient continent; a beautiful little animal; its description, ii. 157

Mucous liquor, giving the joints an easy and ready play, i. 254

Mugil, the mullet, description of this fish, iii. 63

Mule, reputed barren, though Aristotle says it is sometimes prolific, i. 325. Engendered between a horse and a she-ass, or jack-ass and mare; inhabitants of the mountainous countries cannot do without them; how they go down the precipices of the Alps and Andes; a fine mule in Spain worth fifty or sixty guineas; common mule very healthy; lives thirty years and more, 329

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Mummy, formerly a considerable article in medicine; Paræus wrote a treatise on the inefficacy of mummy in physic; counterfeited by the Jews, and how; the method of seeking for mummies; found in the sands of Arabia, in Egypt, in wooden coffins, or in cloths covered with bitumen, i. 286. Remarkable mummy dug up at Auvergne, in France, 288. An injection of petroleum inwardly, and a layer of asphaltum without, suffice to make a mummy, 296

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Murena of the ancients, iii. 47

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Muscle, the shell-fish, its description; its organs of generation are what most deserve to excite our curiosity; it endeavours to become stationary, and to attach itself to any fixed object it happens to be near; its enemies; it is supposed that those threads, which are usually called the beard of the muscle, are the natural growth of the animal's body, and by no means produced at pleasure, as Reaumur supposes; its instrument of motion, by which it contrives to reach the object it wants to bind itself to; its food; some of this kind have

been found a foot long; the natives of Palermo sometimes make gloves and stockings of its beards; the places where found; it requires a year for the peopling a muscle bed, iii. 119

Muscles, to judge of the strength of animals by the thickness of their muscles inconclusive, i. 220. The pectoral muscles of quadrupeds trifling, in comparison to those of birds; in quadrupeds, as in man, the muscles moving the thighs and hinder parts are strongest, while those of the arms are feeble; in birds the contrary obtains, ii. 212. Those of the shark preserve their motion after being separated from the body, iii. 116

Muscovy duck or the Musk duck, so called from its musky smell, ii. 416

Music, said by the ancients to have been invented from the blows of different hammers on an anvil; from the remains of ancient music, collected by Meibomius, one might suppose nothing powerful in what is lost; in all countries where music is in its infancy, the half-tones are rejected; many barbarous nations have their instruments of music, and the proportion between their notes is the same as in ours; all countries pleased with music, and where they have not skill to produce harmony, they substitute noise; its effects, the ancients give us many strange instances of them upon men and animals; and the moderns likewise; madness cured by it; remarkable instance in Henry IV. of Denmark; it is now well known that the stories of the bite of the tarantula, and its cure by music, are all deceptions; instance of it; fishes are allured by music; horses and cows likewise, i. 243. The elephant appears delighted with music, ii. 166. Father Kircher has set the voices of some birds to music, ii. 266

Musk, among the numerous medicines procurable from quadrupeds, none, except the musk and hartshorn, have preserved a degree of reputation, i. 364. Doubt whether the animal producing it be a hog, an ox, a goat, or a deer; no animal so justly the reproach of natural historians as that which bears the musk; it has been variously described, and is known very imperfectly; the description given by Grew; formerly in high request as a perfume; has for more than a century been imported from the East; is a dusky reddish substance, like coagulated blood; a grain of it perfumes a whole room; its odour continues for days without diminution, and no substance known has a stronger or more permanent smell; in larger quantity it continues for years, and scarce wasted in weight, although it has filled the atmosphere to a great distance with its parts; the bags of musk from abroad supposed to belong to some other animal, or taken from some part of the same, filled with its blood and enough of the perfume to impregnate the rest; it comes from China, Tonquin, Bengal, and often from Muscovy; that of Thibet reckoned the best, and of Muscovy the worst, 372, &c.

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Oliver (William), the first who discovered that the application of salad-oil cured the viper's bite effectually, iii. 185

Onager, or the wild ass, is in still greater abundance than the wild horse, i. 325

Ondatra, one of the three distinctions of the musk-rat; a native of Canada; creeps into holes where others seemingly less cannot follow; the female has two distinct apertures, one for urine, the other for propagation; this animal in some measure resembles the beaver; its manner of life during winter, in houses covered under a depth of eight or ten feet of snow; savages of Canada cannot abide its scent, call it stinkard; its skin very valuable, ii. 92

Onza, or ounce, of the panther kind; the onza of Linnæus, i. 441

Ophidium, the gilt head, by sailors called the dolphin, its description, iii. 61

Opossum, an animal in North and South America, of the size of a small cat, and of the monkey kind; its description; the young when first produced are very small, and immediately on quitting the real womb, they creep into the false one, but the time of continuance is uncertain; Ulloa has found five young hidden in the belly of the dam, alive and clinging to the teat, three days after she was dead; chiefly subsists upon birds, and hides among the leaves of trees, to seize them by surprise; cannot run with any swiftness, but climbs trees with great ease and expedition; it often hangs by the tail, and for hours together, with the head downwards, keeps watching for its prey; by means of its tail, flings itself from one tree to another, hunts insects, escapes its pursuers; eats vegetables as well as animal substances; is easily tamed, but a disagreeable domestic from its stupidity, figure, and scent, which, though fragrant in small quantities, is ungrateful when copious; during its gestation, the bag in which the young are concealed may be opened and examined without inconvenience; the young may be counted and handled; they keep fixed to the teat, and cling as firm as if they made a part of the body of the mother, ii. 160, &c.

Orb, description of the sea-orb, also called the sea porcupine; is absolutely poisonous if eaten, iii. 56

Ore of tin is heavier than that of other metals; the basest ores in general the most beautiful to the eye, i. 34

Organs of digestion, in a manner reversed in birds. ii. 215

Ortolan, a bird of the sparrow kind, ii. 334

Osprey, its flesh is admired by many, and when young an excellent food, according to Bellonius, ii. 242. It chiefly lives upon fish, 246. Its distinctive marks, 247

Ostracion, a fish of the cartilaginous kind, is poisonous, iii. 56

Ostrich, manner in which the Arabians hunt them, i. 314, and ii. 232. An Arabian horse of the first speed scarcely outruns them, i. 314. The greatest of birds; makes near approaches to the quadruped class; its flesh proscribed

in Scripture as unfit to be eaten; its description; appears as tall as a man on horseback: brought into England above seven feet high; surprising conformation of its internal parts; a native only of the torrid regions of Africa; not known to breed elsewhere than where first produced; places they inhabit; the Arabians say it never drinks; will devour leather, glass, hair, iron, stones, or any thing given; in native deserts leads an inoffensive social life. Thevenot affirms the male keeps to the female with connubial fidelity; thought much inclined to venery; some of their eggs weigh fifteen pounds, ii. 230, &c. Season for laying depends on the climate where the animal is bred; these birds very prolific, and lay from forty to fifty eggs at one clutch; none has a stronger affection for her young, nor watches her eggs with greater assiduity; sit on them, like other birds, male and female by turns; assiduous in supplying the young with grass, and careful to defend them, encountering every danger bodily; way of taking them among the ancients; the plumes used in their helmets; the ladies of the East use them as ornaments in their dress; plumes used in Europe to decorate our hearses and hats; feathers plucked from the animal while alive more valued than those taken when dead; some savage nations of Africa hunt them for their flesh; Heliogabalus had the brains of six hundred dressed in one dish; one egg sufficient entertainment for eight men; eggs well tasted, and extremely nourishing; Apicius gives a receipt of sauce for the ostrich; of all chases, that of the ostrich, though most laborious, the most entertaining; use they make of its skin; method of hunting of the Struthophagi; its blood mixed with the fat a great dainty with the Arabians; inhabitants of Dara and Libya breed flocks of them; tamed with little trouble; prized for more than feathers in their domestic state; often ridden upon and used as horses; Moore assures he saw a man at Joar travelling upon an ostrich; and Adanson asserts he had two young ostriches, the strongest of which ran swifter than the best English racer, with two negroes on his back; of all animals using wings with legs, in running, these by far the swiftest; parts of it convertible to medicinal purposes; eggs, worst of all to be eaten according to Galen; the American ostrich

Ottar of Roses, a modern perfume, valued for its vegetable fragrance, ii. 52

Otter, the link between land and water animals, resembles terrestrial in make, and aquatic in living; swims faster than it runs; is brown, and like an overgrown weasel; its description; voracious animal, found near lakes; not fond of fishing in running water, and why; when in rivers, always swims against the stream, to meet rather than pursue the fish it preys upon; in lakes, destroys more than it devours, and spoils a pond in a few nights; tears to pieces the nets of the fishers; two different methods of fishing practised by it; infects the edges of lakes with the dead fish it leaves; often distressed for provisions in winter, when the lakes are frozen, and then obliged to live upon grass, weeds, and bark of trees; its retreat the hollow of a bank made by the water; there it forms a gallery several yards along the water; how it evades the fowler; time of coupling; description of its habitation; way of training it up to hunt fish, and, at the word of command, drive them up to the corner of a pond, seize the largest, and bring it in its mouth to its master; to take an old otter alive not easy; few dogs dare to encounter it; marks of its residence; bites with great fierceness, and never lets go its hold; brings forth its young under hollow banks, upon beds of rushes, flags, or weeds; manner of taking the young alive; how fed when taken; continues long without food; couples about Midsummer in Eurpe, and brings forth at nine weeks' end three or four at a time; some dogs trained up to discover its retreat; otters met with in most parts of the world; in North America and Carolina found white, inclining to yellow; description of the Brasilian otter, ii. 121

Ovaria, two glandular bodies near the womb, resembling the cluster of small eggs found in fowls, i. 181

Ouarine, species of monkey so called by M. Buffon, remarkable for the loudness of their voice, and the use to which they apply it, ii. 153

Oviparous animals distinguished from the viviparous, the two classes for generation; all other modes held imaginary and erroneous, i. 183

Ounce, or onza, remarkable for being easily tamed, and employed all over the East for the purpose of hunting, i. 441. Distinguished from the panther, the onza of Linnæus, 439. Does not pursue by the smell like the dog kind; manner of hunting with it, 441

Ourang-outang, the wild man of the wood, an animal nearly approaching the human race, is the foremost of the ape kind; this name given to various animals walking upright, but of different countries, proportions and powers; the troglodyte of Bontius, the drill of Purchas, the pigmy of Tyson, have received this general name; its description in a comparative view with man; gigantic races of it described by travellers truly formidable; many are taller than man, active, strong, intrepid, cunning, lascivious, and cruel; countries where found; in Borneo the quality course him as we do the stag, and this hunting is a favourite amusement of the king; runs with great celerity; its description; Battel calls him pongo, assures us that in all he resembles man, but is larger to a gigantic state; a native of the tropical climates; he lives upon fruits and is not carnivorous; goes in companies, and this troop meeting one of the human species without succour, show him no mercy; they jointly attack the elephant, beat him with clubs, and force him to leave that part of the forest they claim as their own; is so strong that ten men are not a match for it; none of the kind taken but very young; one of them dying, the rest cover the body with leaves and branches; a negro boy taken by one of these, and carried into the woods, continued there a whole year without any injury; they often attempt the female negroes going into the woods, and keep them against their wills for their company, feeding them plentifully all the time; a traveller assures us, that he knew a woman of Loango that lived among them for three years; they build sheds, and use clubs for their defence; sometimes walk upright, and sometimes upon all fours when phantastically disposed; though it resembles man in form, and imitates his actions, it is inferior in sagacity even to the elephant or the beaver; two of these creatures brought to Europe, discovered an astonishing power of imitation, sat at table like men, ate of every thing without distinction, made use of knife, fork, and spoon, drank wine and other liquors; the male of these two creatures being sea-sick, was twice bled in the arm; and afterwards when out of order, he showed his arm as desirous of relief by bleeding; another was surprisingly well behaved, drank wine moderately, and gladly left it for milk or other sweet liquors; it had a defluxion upon the breast, which, increasing, caused its death in the space of one year from its arrival, ii. 139

Owl, description of the common horned-owl; the screech-owl, and its distinctive marks, ii. 242. Common mark by which all birds of this kind are distinguished from others; general characteristics of birds of the owl kind; though dazzled by a bright day-light, they do not see best in darkest nights, as imagined; seasons in which they see best; nights of moonlight the times of their successful plunder; seeing in the night, or being dazzled by day, not alike in every species of this kind; instances in the white, or barn-owl, and in the brown horned-owl; description of the great horned owl; names of several owls without horns; these horns nothing more than two or three feathers that stand up on each side of the head over the ear; times of making their excursions; places where found in the day-time; Father Kircher having set the voices of birds to music, has given all the tones of the owl note, which make a most tremendous melody; sometimes bewildered; what they do in that distress; aversion of small birds to the owl; how they injure and torment him in the day-time; an owl appearing by day sets a whole grove in an uproar; small birds sometimes hunt the owl until evening, when, recovering sight, he makes the foremost pay dear for their sport, and does not always leave man an unconcerned spectator; sport of bird-catchers, by counterfeiting the cry of the owl; in what manner the great horned-owl is used by falconers to lure the kite, when wanted for training the falcon; places where the great horned-owl

breeds; its nest and number of eggs; the lesser owl takes by force the nest of some other bird; number of eggs; the other owls build near the place where they chiefly prey; a single owl more serviceable than six cats, in ridding a barn of mice; an army of mice devoured at Hallontide by a number of strange painted owls; are shy of man, extremely untractable, and difficult to tame; the white owl in captivity refuses all nourishment, and dies of hunger; account of M. Buffon to this purpose, ii. 264, &c.

Ox, on the fertile plains of India it grows to a size four times as large as the same kind bred in the Alps, ii. 270. One in England sixteen hands high, its growth depends on the richness of pasture, i. 340

Oysters, a horse known to be fond of oysters, i. 306. Surprising manner in which monkeys manage an oyster, ii. 154. Bivalved shell-fish are self impregnated; the particulars in which they differ from the muscle; growing even amidst branches of the forest; have no other seeming food than the afflux of sea-water; they are deposited in beds where the tide comes in, at Colchester, and other places of the kingdom; these said to be better tasted; amazing size of oysters along the coast of Coromandel, iii. 122. The pearl oyster has a large whitish shell, the internal coat of which is the mother-of-pearl, iii. 126

P

Paca, improperly called American rabbit, an animal of South America; its cry and manner of eating; is most like the agouti, yet differs in several particulars; its description; places where generally found; its flesh considered a delicacy, and eaten, skin and all, like a young pig; is seldom taken alive, defending itself to the last extremity; persecuted not only by man but by every beast and bird of prey; breeds in such numbers the diminution is not perceptible, ii. 82

Pachomac (deserts), where the formidable bird condor is chiefly seen, men seldom venture to travel, hissing serpents, and prowling panthers, being the scattered inhabitants, ii. 251

Pacific Sea, the winds never change in it, i. 146

Pacos, a kind of camel in South America; its wool very valuable, ii. 189 & 190

Paddock-moon, the silence of the frog in dry weather may serve to explain an opinion, that there is a month in the year so called, in which they never croak, iii. 137

Pain, nothing but repeated experience shows how seldom pain can be suffered to the utmost, i. 258

Painters never fully imitate that bold relievo, which both eyes give to the object, i. 235

Paleness often the effect of anger, and almost ever the attendant of fright and fear, i. 211

Palm-tree, its juice drank by the rousette, or the great bat of Madagascar, ii. 119. The elephant eats the shoots, leaves, and branches to the stump, 159

Pangolin, vulgarly the scaly lizard, is a native of the torrid climates of the ancient continent; of all animals, the best protected from external injury; its description; at the approach of an enemy it rolls itself up like the hedgehog; the tyger, panther, and hyæna, make vain attempts to force this animal, when it rolls itself up like the hedgehog; its flesh is considered by the Negroes of Africa as a great delicacy; it has no teeth; lives entirely upon insects; there is not a more harmless, inoffensive creature, than this unmolested; cunning in hunting for its prey; chiefly keeps in the obscure part of the forests; its tongue, when extended, is shot out about a quarter of a yard beyond the tip of the nose; countries where found, ii. 109

Panther, it naturally hunts the sheep and the goat, i. 303. The foremost of the mischievious spotted kind, by many naturalists mistaken for the tiger; the panther of

Senegal; the large panther; difference between these two; that of America, or jaguar, compared with the two former, i. 438. Sometimes employed in hunting; the gazelle or leveret are its prey; it sometimes attacks its employer, i. 43. Attends to the jackall, ii. 428

Parr, a peasant, live to an hundred and forty-four, without being abstemious, i. 226

Paradise bird, few have more deceived and puzzled the learned than this; it is an inhabitant of the Molucca Islands; erroneous reports concerning this bird, and what has given rise to them; the native savages of those islands carefully cut off its legs before they bring it to market, and why; two kinds of the bird of Paradise; their distinction from other birds; the description of this bird; found tn great numbers in the island of Aro, where the inhabitants call it God's bird; live in large flocks, and at night perch upon the same tree; are called by some the swallows of Ternate, and, like them, have their stated times of return; their king distinguished from the rest by the lustre of his plumage, and the respect and veneration paid to him; killing the king is the best chance of getting the flock; chief mark to know the king is by the ends of the feathers in the tail, having eyes like those of the peacock; a number of these birds taken, the method is to gut them, cut off their legs, dry the internal moisture with a hot iron, and fill the cavity with salt and spices, then sell them to the Europeans for a mere trifle; how this bird breeds, or what the number of its young, remains for discovery; for beauty it exceeds all others of the pie kind, ii. 309

Parakeets, a kind of parrot of a lesser size, ii. 318. Of that kind in Brasil, Labat assures us, they are the most beautiful in plumage, and the most talkative birds in nature, ii. 321. See *Parrot*.

Parasite-plants, not able to support themselves, grow and fix upon some neighbouring tree, i. 178

Parrot, the middle or second size of the kind, described; the ease with which this bird is taught to speak, and the number of words it is capable of speaking, are surprising; a grave writer affirms, that one of these was taught to repeat a whole sonnet from Petrarch; the author has seen one taught to pronounce the ninth commandment articulately; account of a parrot belonging to king Henry VII. which fell into the Thames, crying, *A boat, twenty pound for a boat;* Linnæus makes its varieties amount to forty-seven, Brisson extends his catalogue to ninty-five, and the author thinks them numberless; assertion, that the natives of Brasil by art change the colour of a parrot's plumage; peculiarities observed in their conformation; common enough in Europe, will not however breed here; lose spirits and appetite during the rigour of winter; instances of sagacity and docility, particularly of the great parrot called aicurous; their habits, their nests, and the number of eggs; usual method of taking the young; always speak best when not accustomed to harsh wild notes; what fruit or grain these birds feed upon, the flesh partakes of the flavour and taste; instances of it; seed of the cotton-trees intoxicates them, as wine does man; wine renders them more talkative and amusing; in France very expert, but nothing to those of Brasil, which Clusius says are most sensible and cunning; natives of Brasil shoot them with heavy arrows, headed with cotton, which knock down the bird without killing it; those of the parakeet kind are delicate eating; of this kind in Brasil, Labat assures us they are the most beautiful in plumage, and the most talkative possible; are restless, and ever on the wing; their habits; their outcry when their companions fall; are very destructive on the coast of Guinea; more than a hundred different kinds counted on the coast of Africa; the white sort called lories; countries where found; one, north of the Cape of Good Hope, takes its name from the multitude of parrots in its woods; a hundred kinds now known, not one of which naturally breeds in countries that acknowledged the Roman power; the green parakeet, with a red neck, was the first of the laying twelve; in forests where they breed naturally, they are very numerous;

kind brought into Europe, and the only one known to the ancients, from Alexander the great to Nero; disorders peculiar to the parrot kind; one kept well will live five or six-and twenty years, ii. 318
Parsley, pinks, and birch, hares are particularly fond of, ii. 61
Partridges, in England, a favourite delicacy at the tables of the rich, whose desire of keeping them to themselves has been gratified with laws for their preservation, no way harmonizing with the general spirit of English legislation, and why; there are two kinds, the grey and the red; the grey is most prolific, and always keeps on the ground; the red less common, and perches upon trees; the partridge is found in every country and climate; in Greenland, where it is brown in summer, it becomes white in winter; those of Barakonda are larger legged, swifter of foot, and reside in the highest rocks; partridges of all sorts agree in one character, being immoderately addicted to venery, often to an unnatural degree; the male pursues the hen to her nest, and breaks her eggs, rather than be disappointed; the young having kept in flocks during the winter, break society in spring, when they begin to pair, and terrible combats ensue; their manner otherwise resemble those of poultry, but their cunning and instincts are superior; means the female uses to draw away any formidable animal that approaches her nest; the covies from ten to fifteen, and, unmolested, they live from fifteen to seventeen years; method of taking them in a net with a setting-dog the most pleasant, they are never so tame as our domestic poultry, ii. 290
Passions, most of the furious sort characterised from the elevation and depression of the eye-brows, i. 208. Freedom from passions not only adds to the happiness of the mind but preserves the beauty of the face, i. 254
Pastures, those of Great Britain excellently adapted to quadrupeds of the cow kind, i. 337
Patas, by some called the red African monkey; its description, ii. 356
Paunch, name of the first stomach of ruminating animals, i. 335
Pazan, name of the eighth variety of gazelles by M. Buffon, i. 356
Peacock, a saying among the ancients, as beautiful as is the peacock among birds, so is the tiger among quadrupeds, i. 432. Varieties of this bird; some white, others crested; that of Thibet the most beautiful of the feathered creation; our first were brought from the East Indies; and they are still found in flocks in a wild state in the islands of Java and Ceylon; the common people of Italy say it has the plumage of an angel, the voice of a devil, and the guts of a thief; in the days of Solomon, we find his navies imported from the East apes and peacocks; Ælian relates, they were brought into Greece from some barbarous country; and that a male and female were valued at thirty pounds of our money; it is said also, that when Alexander was in India, he saw them flying wild on the banks of the river Hyarotis, and was so struck, with their beauty, that he laid a fine and punishment on all who should kill or disturb them; the Greeks were so much taken with the beauty of this bird, when first brought among them, that it was shown for money, and many came to Athens from Lacedæmon and Thessaly to see it; once esteemed a delicacy at the tables of the rich and great; Aufidius Hurco stands charged by Pliny with being the first who fatted up the peacock for the feasts of the luxurious; Hortensius, the orator, was the first who served them up at an entertainment at Rome; and they are talked of as the first of viands; in the times of Francis I. it was a custom to serve up peacocks to the tables of the great, not to be eaten, but seen; in what manner they served them; its flesh is said to keep longer unputrified than any other; has a predeliction for barley; but, as a proud and fickle bird, there is scarce any food it will at all times like; it strips the tops of houses of tiles or thatch, lays waste the labours of the gardener, roots up the choicest seeds, and nips favourite flowers in the bud; is still more salacious than the cock; requires five females at least to attend him; and the number not sufficient, will run upon and tread the sitting hen; the pea-hen, as much as possible, hides her nest from him, that he may not disturb her sitting; she seldom lays above five or six eggs in this climate; Aristotle describes her

this bird lives about twenty years; and not till the third year has that beautiful variegated plumage of its tail; in the kingdom of Cambaya, says Tavernier, near the city of Baruch, whole flocks of them are in the fields; description of their habits; decoy made use of to catch them there, ii. 276 &c.

Peacock (sea), a name given, and by which has been described the Balearic crane, some resemblance in disposition and manner, ii. 364

Pearl, an animal substance concreted and taking a tincture from the air; found in all bivalved shells, the inside of which resemble that substance called mother-of-pearl; the formation of pearls a disease or an accident in the animal, is not known; common opinion upon this subject; the pearl bred from no disorder in the animal; *pearl-oyster*, from which the mother-of-pearl is taken; several pearl-fisheries; the chief of them in the Persian Gulf, and the most valuable of pearls brought from thence; different sizes, figures, and colours; whence their different colours proceed; pearls converted by time and damps into a chalky powder; wretched people destined to fish for pearls; usually die consumptive; in what manner they fish for them, iii. 124

Pearls, in stags, are parts rising from the crust of the beam, i. 384

Peccary, or tajacu, an animal, a native of America, at first view resembling a small hog; its description; has upon the back a lump like the navel in other animals; it consists of glands producing a liquor of an offensive smell; when killed, the parts of generation, and the glands on the back, must be taken instantly away, otherwise in half an hour, the flesh becomes unfit to be eaten; though like the hog in many respects, is nevertheless a distinct race, and will not mix or produce an intermediate race; is easily tamed; goes in herds of two or three hundred, and unite, like hogs, in each other's defence; delights not in marshes or mud, like our hogs; an unceasing enemy to the lizard, the toad and the serpent kinds; also feed upon toads and serpents; any plunderer seizing their young, is surrounded, and often killed, i. 404

Pedigree, the Arabians preserve that of their best horses with great care, and for several generations back, i. 314

Pelagii, the Latin name for those shells fished up from the deep; those cast on the shore are littorales, ii. 107

Pelican, a native of Africa and America: once known in Europe, particularly in Russia; fabulous accounts propagated of it; the description of it, particularly of its bill, and the great pouch underneath, as wonderful; Tertre affirms the pouch will hide flesh enough to serve sixty hungry men for a meal; this pouch, placed at the top of the gullet, considered as the crop in other birds; the description of the bird from Father Labat; indolent habits in preparing for incubation, and defending their young; their gluttony scarcely to be satisfied; their flesh rancid, and taste worse than it smells; use made by the Americans of their pouches; is not entirely incapable of instruction in a domestic state; instances of it; Aldrovandus mentions one believed to be fifty years old, ii. 386

Penguin, union between this bird and the albatross, and regularity in their building together, ii. 391. A heavy water-fowl; the wings unfit for flight; and their legs still more awkwardly adapted for walking; our sailors call them arse-feet; they dive to the bottom, or swim between two waters; they never visit land but when coming to breed; their colour; are covered more warmly with feathers than other birds; description of the Magellanic penguin; they unite in them the qualities of men, fowls and fishes; instances of its glutinous appetite; their food and flesh; are a bird of society; season of laying, and manner of making their nests; some of this tribe called by our seamen the booby; our men first coming among them were not mistrusted or avoided; they stood to be shot at in flocks, till every one was destroyed; the females let them take eggs without any resistance; the penguin lays but one egg, in frequented shores; burrows like a rabbit; three or four take possession of one hole, and hatch; one is placed as a centinel to warn of approaching danger, ii. 481

Peninsula (of India), on one side the coasts are near half the year harrassed by violent hurricanes, and northern tempests, i. 148. The people there employ the elephant chiefly in carrying or drawing burdens, ii. 174

Penpark-hole, in Gloucestershire, twenty-five fathoms in perpendicular depth; its description from Captain Sturmey, i. 30

Pepper, the Indians prefer that devoured and voided, unconcocted by the toucan, before the pepper fresh gathered from the trees, ii. 304

Perch, a prickly-finned thoracic fish; its description, iii. 62

Perfumes, some physicians think all perfumes unwholesome; our delight in perfumes seems made by habit; many bodies at a distance give an agreeable perfume, and nearer have a most ungrateful odour, i. 207. No perfume has a stronger or more permanent smell than musk, 173. The scent of the martin a most pleasing perfume, ii. 41. Some of the weasel kind have a smell approaching to perfume, 47. That of the musk or the civet is nothing to the stinkards, ib. In what manner taken from the pouch; more grateful perfume than musk; that of Amsterdam the purest of any; is communicated to all parts of the animal's body; the fur impregnated, and the skin also; a person shut up in a close room, cannot support the scent; this perfume sold in Holland for about fifteen shillings an ounce; it has no analogy with the creature's appetite for generation; a proof of it; has its vicissitudes of fashion, like dress, 52

Persia, the horses of that country the most beautiful and most valuable of all in the east, i. 322. There are studs of ten thousand white mares together, with the hoof so hard, that shoeing is unnecessary, 317. The flesh of the wild ass so much liked that its delicacy is a proverb there, 325. Two kinds of asses there, and some of them worth forty or fifty pounds, i. 329, A noted country for giving long soft hair to the animals bred in it, i. 425. Lions found to diminish in number in this country, i. 424. The bird of Persia is the common cock of Aristophanes, ii. 371

Persian Gulf, a very dangerous wind prevails, by the natives called the sameyel; it suddenly kills those it involves in its passage, and frequently assumes a visible form, darting in a bluish vapour along the surface of the country; the poets of Persia and Arabia have described it as under the conduct of Vengeance, who governs its terrors, and raises or depresses it, as she thinks proper, i. 153. The chief pearl-fishery carried on there, iii. 125. That Gulf choked up in many places with coralline substances, iii. 326

Prespiration, an experiment from which the learned may infer upon what foundation the doctrine of Sanctorian perspiration is built, i. 219

Peruvians, Father Acosta, and Garcillasso de la Vega, make no doubt but that they understood the art of preserving their dead for a long space of time, i. 284

Petrel, or gull, described, ii. 396

Petroleum, an injection of this bituminous oil inwardly, and an application of asphaltum without, suffice to make a mummy, i. 290

Pettichaps, a bird of the sparrow kind, ii. 333

Phalanges, a kind of opossum; its description; has been called the rat of Surinam, ii. 162

Phatagin, an animal less than the pangolin; the extent of its tail above twice the length of its body; countries where it is to be found, ii. 111

Pheasants, at first propagated among us, brought into Europe from the banks of the Phasis, a river of Colchis, in Asia Minor, whence they still retain their name; Crœsus, king of Lydia, seated on his throne, adorned with the barbarous pomp of eastern splendour, asked Solon whether he ever beheld anything so fine? Solon replied, that having seen the beautiful plumage of the pheasant, no other finery could astonish him; description of this beautiful bird; its flesh the greatest dainty; animals of the domestic kind once reclaimed, still continue domestic, and persevere in the habits and appetites of willing slavery; but the pheasant taken from its native warm retreats, still continues his attachment to native freedom; and, wild among us, is an envied

ornament of our parks and forests, where he feeds upon acorns and berries; in the woods the hen pheasant lays from eighteen to twenty eggs in a season, but in a domestic state seldom above ten; when wild, she hatches and leads up her brood with patience, vigilance, and courage; but when tame she never sits well; and a common hen becomes her substitute; and as for leading her young to their food, she is utterly ignorant where it is found; and the young would starve if left solely to her management; it is better left at large in the woods than reduced to its pristine captivity; its fecundity, when wild, is sufficient to stock the forest, and its flesh acquires a higher flavour from its unlimited freedom; its habits when tame; no birds are shot more easily; when physicians of old spoke of wholesomeness of viands, the comparison lay with the flesh of the pheasant; these birds taken young into keeping, become as familiar as chickens; and when designed for breeding, they are put together in a yard, five hens to a cock; their nest in its natural state; the female refusing to hatch the eggs, a common hen supplies her place, and performs the task with perseverance and success; the young difficult to be reared; with what food the young must be supplied; particularities concerning the the rearing of the young ones; the method of Longolius to increase the breed and make it more valuable; the pheasant will at last be brought to couple with a common hen; many varieties of pheasants; of all others, the *golden pheasant* of China the most beautiful, ii 281, &c.

Pholades, the file-fish, places where these animals are found; their power of penetrating; the pillars of the temple of Serapis at Puteoli were penetrated by them; they pierce the hardest bodies with their tongue; their motion slow beyond conception; have no other food but the sea-water; are accounted a great delicacy, iii. 127

Pie, in the class of the pie kind, few, except the pigeon, are of use to man; yet, to each other, no class of birds so ingenious, active, and well fitted for society; they live in pairs, and their attachments are confined to each other; they build nests in trees or bushes; the male shares in the labour of building, and relieves his mate in the duties of incubation; and the young once excluded, both are equally active in making them ample provision; general laws prevail, and a republican form of government is established among them; they watch for the general safety of every bird of the grove; they are remarkable for instinct and capacity for instruction; instances of it; fetching and carrying untaught, all this tribe are but too fond of; their passion for shining things, and such toys as most of us put a value upon; rings found in the nest of a tame magpie; the few general characters in which they all agree, ii. 294

Pie (sea), breeds in this country, and resides in its marshy parts, ii. 378

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often; the pigeons called carriers used to convey letters; not trained with so much care as formerly, when sent from a besieged city to those coming to relieve it; in an hour and a half they perform a journey of forty miles; the last public use made of them was to let them off at the place of execution, when the cart was drawn away from under the malefactor, ii. 323
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Pigmy of Tyson, the ourang-outang, or the wild man of the woods, ii. 141
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Polar regions, description of them, 5. And of the inhabitants around them, i. 260

Polecat, a distinct species from the ermine. Resembles the ferret so much, that some have thought them to be the same animal; there are many distinctions between them; warreners assert the polecat will mix with the ferret; M. Buffon denies it; description of the polecat; very destructive to young game; the rabbit its favourite prey; and one polecat destroys a whole warren by wounds hardly perceptible; generally reside in woods or thick breeks, making holes two yards deep under ground; in winter they rob the hen-roos tand the dairy; particularly destructive among pigeons; and feast upon their brains; fond also of honey; female brings forth in summer five or six young at a time, and supplies the want of milk with the blood of such animals as she can seize; the fur is in less estimation than of inferior kinds, and why; an inhabitant of temperate climates, being afraid of cold as well as heat; the species confined in Europe to a range from Poland to Italy, ii. 40. Polecat of America and Virginia are names for the squash and the skink; distinctions of those animals, 47. Seizes the flying squirrel, 75

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Polypus, very voracious; its description; uses his arms as a fisherman does his net; is not of the vegetable tribe, but a real animal; examined with a micro-

scope, several little specks are seen like buds, that pullulate from different parts of the body, and these soon appear to be young polypi, beginning to cast their little arms about for prey; the same food is digested, and serves for nourishment of both; every polypus has a colony sprouting from its body; and these new ones, even while attached to the parents, become parent themselves, with a smaller colony also budding from them; though cut into thousands of parts, each still retains its vivacious quality, and shortly becomes a distinct and a complete polypus, fit to reproduce upon cutting in pieces; it hunts for its food, and possesses a power of choosing it, or retreating from danger, i. 184. Dimensions of the sea polypus, and of that which grows in fresh waters; the power of dissection first tried upon these animals to multiply their numbers; Mr. Trembly has the honour of the first discovery of the amazing properties and powers of this animal; this class of animals divided into four different kinds; method of conceiving a just idea of their figure; manner of lengthening or contracting itself; progressive motion; no appearance of an organ of sight found over the whole body; inclined to turn towards the light; their way of living; arms serve them as lime-twigs do a fowler; how it seizes on its prey; testifies its hunger by opening its mouth; having seized the prey, opens its mouth, in the proportion to the size of what it would swallow, whether fish, flesh, or insects; when two mouths are joined upon one common prey, the largest swallows his antagonist; but after lying in the conqueror's body for about an hour, it issues unhurt, and often in poesession of the prey of contention; the cold approaching to congelation, they feel the general torpor of nature, and their faculties are for two or three months suspended; such as are best supplied, soonest acquire their largest size, but they diminish also in their growth with the same facility, if their food be lessened; some propagated from eggs, some produced by buds issuing from the body as plants by inoculation, while all may be multiplied by cutting to an amazing degree of minuteness; of those produced by buds issuing from the parent stem, should the parent swallow a red worm, it gives a tincture to all its fluids, and the young partakes of the parental colour; but if the latter should seize upon the same prey, the parent is no way benefited by the capture, all the advantage thus remains with the young; several young of different sizes are growing from its body; some just budding forth, others acquiring perfect form, and others ready to drop from the original stem; those young still attached to the parent, bud and propogate also, each holding dependence upon its parent; artificial method of propagating these animals by cuttings; Mr. Hughes describes a species of this animal, but mistakes its nature, and calls it a sensitive flower plant, iii. 319

Polypus-coral, the work of an infinite number of reptiles of that kind, iii. 325. In every coralline substance are a number of polypi, ib.

Pongo, name given by Battel to the ourang-outang, ii. 143

Poppies affect with drowsiness those who walk through fields of them, or are occupied in preparing the flowers for opium, i. 140

Porcelain, an artificial composition of earth and water, united by heat, i. 72

Porcupine, an enlarged hedgehog; its description; of all those brought into Europe, not one ever seen to launch its quills, though greatly provoked; their manner of defence; directs its quills pointing to the enemy; Kolben relates, the lion then will not venture an attack; feeds on serpents and other reptiles; the porcupine and serpent are said never to meet without a mortal engagement, how it destroys and devours them; of Canada subsists on vegetables; those brought to this country for show, usually fed on bread, milk, and fruits, do not refuse meat when offered; is extremely hurtful to gardens; the Americans, who hunt it, believe it lives from twelve to fifteen years; during the time of coupling, in the month of September, the males become fierce and dangerous, and often destroy each other with their teeth; time of gestation; the female brings forth one at a time; she suckles it about a month, and accustoms it to live, like herself, upon vegetables and the bark of trees; the female very fierce in the defence of her young; at other seasons fearful, timid, and

harmless; never attempts to bite or any way injure its pursuers; manner of escaping, when hunted by a dog or a wolf; the Indians pursue it to make embroidery with its quills, and eat its flesh; circumstances concerning it remaining to be known; little known with precision, except what offers in a state of captivity; description of one kept in an iron cage; the porcupine of America differs much from that of the ancient continent; two kinds, the couando and the urson; description of both, ii. 104

Porcupine of the Sea, described, iii. 54

Pork, unpalatable with us in summer, is the finest eating in warmer latitudes, and preferable to hog's flesh in Europe, i. 326

Porpoise, a fish less than the grampus, with the snout of a hog; its description and habits; a fishery for them along the Western Isles of Scotland, in the summer season, when they abound on that shore; live to a considerable age, though some say not above twenty-five or thirty years; sleep with the snout above water; possess, proportionably to their bulk, the manners of whales; places where they seek for prey; destroy the nets of Cornwall; manner of killing them in the Thames; yield a large quantity of oil; the lean of some, not old, said to be as well tasted as veal; caviar prepared from the eggs of this fish, iii. 26

Ports choked up with sand by the vehemence of the wind, i. 149

Pouch, or bag, of the civet, differs in its opening from that of the rest of the weasel kind; description of it, ii. 51. Of the bustard, under the tougue, capable of holding near seven quarts of water, ii. 286. Of the pelican, hides as many fish as will serve sixty hungry men for a meal; its description, 387

Poultry, general characteristics of the poultry kind; they live together; and each conscious of his strength, seldom tries a second combat, where he has been once worsted; kept in the same district, or fed in the same yard, they learn the arts of subordination; the young of the kind, not fed with meat put into their mouths, peck their food; the female intent on providing food for her young clutch, and scarce takes any nourishment at all; among the habits of this class of birds is the peculiarity of dusting themselves; nearly all domestic birds of this kind, maintained in our yards, are of foreign extraction; the courtship of this kind is short, and the congress fortuitous; the male takes no heed of his offspring; though timorous with birds of prey, he is incredibly bold among his own kind; the sight of a male of his own species produces a combat; the female takes all the labour of hatching and bringing up her young, choosing a place remote from the cock, ii. 269, &c.

Powisland, in Wales, for many ages famous for a swift and generous race of horses, and why, i. 322

Powters, a variety of the tame pigeon, ii. 326

Pregnancy of some women found to continue a month beyond the usual time, i. 193. Of all animals, in point of time, is proportioned to their size, 309

Pressure, perpendicular in rivers, always in exact proportion to the depth, i. 87

Prey, all the males of these birds are a third less, and weaker than the females, ii. 241. See *Birds*.

Pricket, name hunters give the buck the second year, i. 390

Prickly-finned fishes, their description, iii. 61

Propagation of gnats, one of the strangest discoveries in natural history, iii. 309. A new kind lately discovered in a most numerous tribe of animals, propagated by cuttings, 313. Different manners of that operation in the polypi, to the astonishment of the learned of Europe, 314

Propolis, a resinous gum, with which the bees plaster the inside of their hives, iii. 275

Proportion of the human figure, little known with precision in regard to it; different opinions upon the subject, i. 217

Ptarmigan, sort of grouse, chiefly found in heathy mountains and piny forests, at a distance from mankind; size and colour, ii. 287

Phthiriases, the lousy disease, frequent among the ancients; principal people who died of this disorder; plants and animals are infested with diseases of

this kind; a vegetable louse from America overrun all the physic-garden at Leyden; the leaf-louse described; the males have four wings, the females never have any; when they perceive the ant behind them, they kick back with their hind-feet; three principal and constant enemies to these insects, iii. 211

Puffin, or Coulterneh, marks that distinguish this bird; its residence; migrations; found by hundreds cast away upon shores lean and perished with famine; lays one egg; few birds or beasts venture to attack its retreats; in what manner it defends itself against the raven; the Manks puffin is itself one of the most terrible invaders; instances of it; places which abound with them; in what manner their young are fed; their food; formerly their flesh was allowed by the church on lenten days; they bite extremely hard, and keep such hold of what they seize, as not to be easily disengaged; their noise when taken very disagreeable, like the efforts of a dumb person attempting to speak; quantity of oil in their bodies, ii. 405

Purre, a small bird of the crane kind, with a shorter bill, and thighs bare of feathers, ii. 376

Puteoli, a city swallowed up by an earthquake, had a temple of Serapis, the pillars of which, while under water, were penetrated by the pholas, or file-fish, iii. 129

Putrefaction, a supposed cause of animal life; late discoveries have induced many to doubt whether animal life cannot be produced merely from thence, i. 183

Pyramids of Egypt, one of them entirely built of a kind of freestone, in which petrified shells are found in great abundance, i. 23

Pyrites, their composition; sulphur and iron blended and heated with air or water, will form these, and marcasites, i. 34

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Quadrupeds, of all ranks of animated nature, bear the nearest resemblance to man, are less changed by influence of climate or food than the lower ranks of nature; some are of so equivocal a nature, it is hard to tell whether they ought to be ranked in this class, or degraded to those below them; instances of it, i. 298. The weaker races exert all efforts to avoid their invaders, 301. Next to human influence, the climate seems to have the strongest effects upon their nature and form, 306. Both at the line and the pole, the wild are fierce and untameable, 307. One class of these entirely left to chance, no parent stands forth to protect them, and no instructor leads, or teaches them the arts of subsistence, these bring forth above two hundred young at a time, 310 America inferior to us in these productions; opinion, that all in South America are a different species from those most resembling them in the old world; such as peculiarly belong to the new continent, are without any marks of the perfections of their species, 308. The large and formidable produce but one young at a time, while the mean and contemptible are prolific; wisely ordered so by Providence, 310. Those that are amphibious have motion in the lower eyelid alone, 208. Those that ruminate are harmless, and easily tamed; they are chiefly the cow, the sheep, and the deer kind, 334

Quagga, an animal resembling the zebra, but distinct from it, i. 330

Quail, a bird of passage; description of it; time of its migrations; opinion, that it only goes from one part of a country to another; their long journeys doubtful; how caught by a call; number of their eggs; fight desperately at the season of courtship, and easily taken at that time, ii. 292

Quail-fighting, a favourite amusement among the Athenians; abstained from the flesh of this bird, supposing it fed upon white hellebore; reared numbers of them for fighting, and betted sums of money, as we do on cocks, ii. 293

Quicksilver, remarkable effects of it at the mines near Idra, related by Dr. Pope, i. 56. The heaviest substance in the world except gold; floats upon

water by a particular experiment, 81. Seventy-one pounds and a half equal in bulk to a hundred pound weight of gold, 82

Quills (of the porcupine), the Indians embroider with them their belts, baskets, and several other necessary pieces of furniture; inquiry whether the quills of the porcupine can be sent off with a shake, ii. 106

Quito, in South America, capital city of, one of the most charming regions upon earth; this part higher than any other country in the world, i. 65

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Rabbits have eyes of a red colour, i. 208. Rabbit and hare of distinct kinds; refuse to mix with each other; instance of it; few quadrupeds can overtake the rabbit in a short run, ii. 66. A creature covered with feathers and hair, said to be bred between a rabbit and a hen; their fecundity greater than that of the hare; breed seven times a-year, and bring eight young each time; love the sunny field, and open pasture; the female suckles the young about a month; the male attends the young, leads them out, and conducts them back; have an external retreat at a distance from the warren, as a kind of country-house; female brings forth in a part of the warren separate from the male, and digs herself a hole, more intricate, at the bottom of which is a more ample apartment; some hair she pulls from her belly makes a bed for her young; the male, after six weeks, acknowledges them as his offspring, smooths their skin, and licks their eyes, 67

Rabbits (tame), in a warren, continue exposed to weather, without burrowing; in two or three generations, they find the necessity of an asylum; various colours of rabbits; the mouse colour kinds originally from an island in the river Humber; still continuing their general colour, after a number of successive generations; account of their production; surprising obedience and submission of descendants, to their common parent; the descendants quarrelling, his appearance restores peace and order; sometimes he punishes them as an example to the rest; other instances of superiority of the common parent; the rabbit generally fatter, and lives longer than the hare; its flesh less delicate; native of the warmer climates; it has been imported into England from Spain; in some of the islands of the Mediterraneam they multiplied in such numbers that military aid was demanded to destroy them; love a warm climate; English counties most noted for them; delight in a sandy soil; the tame larger than the wild; indulged in too great plenty of moist food, as the feeders express it, are apt to grow rotten; their hair employed in England for several purposes; the skin of the male preferred, ii. 68

Rabbit (Syrian), remarkable for the length, gloss, and softness of its hair, ii. 70. In some places curled at the end like wool, and shed once a-year in large masses, and some part dragging on the ground, appears like another leg or a longer tail; no rabbits natural in America; those carried from Europe multiply in the West-India islands abundantly; on the continent there are animals resembling the European rabbits, ib.

Rabbit (Brasilian), shaped like the English, but without a tail; does not burrow like ours, and is not above twice the size of a dormouse; Guinea-pig placed by Brisson among animals of the rabbit kind, ii. 83

Racoon, with some the Jamaica rat; its description and habits; do more injury in one night in Jamaica, than the labours of a month can repair; capable of being instructed in amusing tricks, drinks by lapping, as well as by sucking; its food, ii. 196

Rainbows, circular rainbows in the Alps, i. 63. And between the tropics, and near the poles, 161. One of the three rainbows seen by Ulloa, at Quito, was real, the rest only reflections thereof; a glass globe, filled with water, will assume successively all the colours of the rainbow; upon the tops of very high mountains circular rainbows are seen, and why; a lunar rainbow, near the poles, appears of a pale white, striped with grey; the solar rain-

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Ranguer, the name of the ninth variety of gazelles, made by M. Buffon, i. 367
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but one vent for propagation, excrement, and urine; they continue to live some time after their nobler parts are wounded, or taken away; their note, according to Kircher, an ascending and descending hexachord, uttered only by night; their look piteous, to move compassion; accompanied with tears, that dissuade injuring so wretched a being; one fastened by its feet to a pole, suspended across two beams, remained forty days without meat, drink, or sleep; an amazing instance of strength in the feet, ii. 201

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Squash, a stinkard of the weasel kind, called a polecat of America; its description; is said to eat only the brains of poultry; its scent strong enough to reach half a mile round; near hand, almost stifling; a drop of the fetid discharge falling into the eye, might blind it for ever; dogs abate their ardour when they meet the fetid discharge, turn, and leave the squash master of the field, never to be led on again; cows and oxen strongly affected by the stench, and provisions spoiled by it; with planters and native Americans, kept tame about their houses; seldom emitting disagreeable scents, except when injured or frightened; natives eat the flesh, taking care to clear it of the offensive glands, ii. 47

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Squirrel, the tails are extremely long, beautiful, and bushy, and serve them for several purposes; particularly in vast leaps of one hundred yards taken from tree to tree; when the animal eats, or dresses itself, it sits erect, like the hare or rabbit, making use of its fore feet as hands; the kind has as many varieties as any wild animal; enumeration of some; its way of moving is by bounds; when tamed, is apt to break away at every opportunity; few animals so tender, or so unfit for a change of abode; some live on the tops of trees, others feed on vegetables below, where also they take shelter in storms; description of its qualities, food, and mansion; the nest formed among large branches, where they fork off into small; the martin destroys the squirrel, then takes possession of its mansion, ii. 70

Squirrels are in heat early in the spring; very diverting to see the female then feigning an escape from the pursuit of two or three males; time of gestation; keeps in the midst of the tallest trees, and shuns the habitation of men; the tree but touched at the bottom, they quit the nest, and fly to another tree, thus travelling with ease along the tops of the forest, until quite out of danger; in Lapland, vast numbers remove from one part to another; method of crossing broad rivers, or extensive lakes; they have a sharp piercing note, and another more like the purring of the cat when pleased; the Laplanders eat their flesh; description of the *common sort*, and of the *grey Virginian kind*; the *Barbary*; *Sibernian white*; *Carolina black*; *Brasilian*; *little ground Carolina*, and *New Spain squirrel*;—*flying squirrel* more common in America than in Europe; its food, and mansion, ii. 73, &c.

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found to partake of the nature of the soil; a mistake that horns take colour of the sap of the tree against which they are rubbed; stag castrated when its horns are off, they never grow again; the same operation performed when they are on, they never fall off; one testicle only tied up, he loses the horn of the opposite side; M. Buffon thinks the growth of the horns retarded by retrenching the food; horns resembled to a vegetable substance, grafted upon head of the stag; time of feeling impressions of the rut, or desire of copulation; effects the rut causes; stag lives about forty years; voice in the time of rut terrible, and then keeps dogs off intrepidly; a stag and tiger enclosed in the same area, the stag's defence so bold the tiger was obliged to fly; the stag in rut, ventures out to sea from one island to another, and swims best when fattest, i. 376. The hind, or female, uses all her arts to conceal her young from him, the most dangerous of her pursuers; men of every age and nation made the stag chase a favourite persuit; stags remaining wild in England, called red deer, found on the moors bordering Cornwall and Devonshire; manner of hunting stag and buck in England; different names given them, according to their ages; terms used by the hunters pursuing the stag; the manner of knowing the track of a stag; and that of a hind; he changes his manner of feeding every month, in what manner; swims against the stream; the ancient manner of pursuing him; that of hunting him; and in China; stag of Corsica; a kind called by the ancients *tragelaphus;* Germans call it *bran-deer*, or *brown-deer;* a beautiful stag, thought a native of Sardinia, though perhaps of Africa, or the East Indies; its description; *stag royal* in Mexico; *of Canada*, brought into a state of domestic tameness, as our sheep, goats, and black cattle, 381, &c.

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Star-fish, general description of the tribe; substance of their bodies almost as soft as water; no way injured by swallowing shells almost of a stony hardness; float upon the surfoce of the sea, and in the dark sends forth a shining light, resembling that of phosphorus; called *sea-nettles;* the passage for devouring fish serves to eject excrements; taken and put into spirits of wine continue many years entire; but left to influence of air, in four-and-twenty hours melted down into a limpid offensive water; cut in pieces, every part survives the operation, becoming a perfect animal, endued with its natural rapacity, iii. 317

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Stars (falling), meteors, or unctuous vapours raised from the earth, kindled and supported in the air, until they fall back extinguished, i. 165

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Stinkards, name given by our sailors to one or two animals of the weasel kind, chiefly found in America, ii. 47. And by the savages of Canada to the musk-rat, 93

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Sturgeon, a cartilaginous fish, of a considerable size, yet flies terrified from the smallest fishes; its description; countries of Europe this fish visits at different seasons; annually ascends the largest rivers to spawn, and propagates in vast numbers, enjoying the vicissitudes of fresh and salt water, then grows to an enormous size, almost to rival the whale; the largest caught in Great Britain taken in the Esk, were frequently found weighing four hundred and fifty pounds; places where caught in numbers; never by a bait, always in nets; their food; whence the German proverb, *He is as moderate as a sturgeon;* live in society among themselves, and Gesner has seen them shoal together at the notes of a trumpet; usual time of coming up rivers to spawn; at Pillau

the shores formed into districts, and allotted to companies of fishermen, and rented, some for three hundred pounds a-year; nets in which caught; in the water it is one of the strongest fishes, and often breaks through the nets that enclose it, but its head one raised above water, its activity ceases; has broke fishermen's legs with a blow of its tail; two methods of preparing it; that from America not so good as from the north of Europe; caviar made with the roe of all kinds of sturgeon; manner of making it, iii. 49

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Swan, a stately web-footed water fowl; though an indifferent figure upon land, is beautiful in the water; doubt whether the tame kind be in a state of nature; none found in Europe; the wild swan, though strongly resembling it in colour and form, yet another bird; differences between wild and tame swans; considered a high delicacy among the ancients; the tame most silent, the wild has a loud and disagreeable note; from thence called the *hooper;* accounts sufficient to suspend an opinion of its musical abilities; their food, nest, and number of eggs; a blow with the pinion breaks a man's leg or arm; two months hatching, and a year growing to proper size; longest in the shell of any bird; said to live three hundred years; by an Act of Edward IV. the son of the King was allowed to keep a swan, and no others, unless possessed of five marks a year; punishment for taking their eggs was, imprisonment for a

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lying down by the way, becomes their prey, and is devoured alive; attempt oxen grazing, destroy lambs, and feed much upon serpents, rabbits, hares, and what game they can overpower; demolish whole broods of crocodiles; lay two eggs at a time, and produce but once a-year; make nests in inaccessible cliffs, and remotest places; their flesh lean, stringy, nauseous, tasting and smelling of carrion; the down of their wings makes a pretty kind of fur, commonly sold in the Asiatic markets, 252, &c.

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Whale, the largest animal known; no precise anatomy of this fish yet given; seven different kinds, distinguished by external figure, or internal conformation; are gregarious animals; make migrations from one ocean to another, and generally resort where they have the least disturbance; great Greenland whale, its description; from sixty to seventy feet long; the head one third of its bulk; its hearing is acute; breathes air at the surface of the water, and can-

not remain under water like other fishes; it blows loudly through the spout-holes, and most fiercely when wounded; whalebone different from the bones of the body; the fins are from five to eight feet long; the throat so narrow, nothing larger than a herring can be swallowed; the tail, its only weapon of defence, is twenty-four feet broad, and strikes hard blows; one seen by Ray marbled, with the figures 122 distinctly marked upon it; the flesh palatable to some nations; the female and male keep much together; their fidelity exceeds that of birds; do not cross breeds; she goes with young nine or ten months, is then fatter than at other times; produces two breasts and teats at pleasure; suckles her young a year, and how; is very tender of them; defends them fiercely when pursued; dives with them, and comes up soon to give them breath; during the first year called short heads, and then yield fifty barrels of blubber; at two years they are stunts, and after that skull-fish; the food of this animal, an insect called medusa by Linnæus, and walfischoas by the Icelanders; pursues no other fish, and is inoffensive in its element; the whale-louse, of the shell-fish kind, sticks to its body, as to the foul bottom of a ship, gets under the fins, and eats through the skin into the fat; the sword-fish affrights the whale, avoids the stroke of its tail, bounds upon its back, and cuts into it with the toothed edges of its bill; the killer, a cetaceous fish of great strength, with powerful teeth, besets the whale as dogs do a bull, tears it down, and then devours only its tongue. old manner of taking whales; improvements hinted, iii. 16, &c.

Whale (Spermaceti), the cachalot, has teeth in the under jaw; is less than the whale, about sixty feet long, and sixteen high; can remain longer under water, and the head makes one-half of the whole; is voracious and destructive even to dolphins and porpoises; seven distinctions in this tribe; contain two precious drugs, the spemaceti and ambergris; the latter mostly in older fishes, iii. 27. See *Cachalot*

Wheat-ear, a thick short-billed bird of the sparrow kind, thought foreign, ii. 334. It migrates before winter, 335

Whin-chat, a slender-billed bird of the sparrow kind, ii. 333. Bird of passage, 335.

Whip-snake, a very venomous serpent of the East, is five feet long, and its bite kills in six hours' time, iii. 189

Whirlpool, manner in which it is formed, i. 114. Those of the ocean particularly dangerous, 115. The central point always lowest, and why, 88

Whirlwind, the most rapid formed by united contributions of minerals, vegetables, and animals, increasing the current of air, i. 145

Whiskers, a man without them formerly considered as unfit for company in Spain; nature denying, art supplied the deficiency; a Spanish general borrowing money from the Venetians, pawned his whiskers and took care to release them; part of the religion of the Tartars consists in the management of their whiskers; and they waged war with the Persians, as infidels, whose whiskers had not the orthodox cut; the kings of Persia wore them matted with gold thread; and the kings of France, of the first races, had them knotted and buttoned with gold, i. 213

Whiston, his reasoning concerning the theory of the earth; finds water enough in the tail of a comet for the universal deluge, i. 12

White the natural colour of men, all other tints proceed from greater or lesser heat of climates, i. 268. Among white races of people, our own country bids fairest for pre-eminence, 269

White-bait, shoals appear near Greenwich in July, and seem the young of some animal not come to perfect form, iii. 74

White-nose, the moustoc, monkey of the ancient continent, a beautiful little animal; its description; a native of the Gold Coast, ii. 157

White-throat, a slender-billed bird of the sparrow kind, living upon insects; ii. 333

Widgeon, a variety of the European duck, described, but best known by its whistling sound, ii. 416

Wild man of the woods, the ourang outang, foremost of the ape kind; this name given to various animals walking upright, but from different countries, and of differents proportions and powers; the *troglodyte* of Bontius, the *drill* of Perchas, *pigmy* of Tyson, and *pongo* of Battel, have all this general name, ii. 139

Wind, a current of air; artificial; causes assigned for the variety, activity, continual change, and uncertain duration of it; in what manner to foretel the certainty of a wind, as the return of an eclipse; to account for variations of wind upon land, not at present expected; recourse to be had to the ocean, and why; in many parts of the world the winds pay stated visits; in some places they blow one way by day, and another by night; in others, for one half-year they go in a direction contrary to their former course; in some places the winds never change; the wind which never varies is the great universal wind, blowing from the east to the west, in all extensive oceans, where the land does not break the general current; the other winds are deviations of its current; many theories to explain the motion of the winds; that of Dr. Lyster; theory of Cartesius; Dr. Halley's more plausible, i. 144

Winds (trade) blow from the poles towards the equator; were the surface of the globe sea, the winds would be constant, and blow in one direction; various circumstances break its current, and drive it back against its general course, forcing it upon coasts that face the west; want of a true system of trade winds supplied by an imperfect history of them; north wind prevails during October, November, December, and January, in the Atlantic, under the temperate zone; north wind reigns during the winter of Nova Zembla, and other arctic countries; south wind prevails during July in the Cape de Verde Islands; north-west wind blows during September at the Cape of Good Hope; regular winds produced by various causes upon land; ancient Greeks first observed them; in general, wherever a strong current of water, there is a wind to atend it; regular wind produced by the flux and reflux of the sea; winds called *monsoons;* some peculiar to certain coasts; south wind constant upon those of Chili and Peru; other winds particular to various coasts, 147

Winds (at land) puff by intervals, and why; not so at sea; east wind more constant than any other, and generally most powerful; wind blowing one way, and clouds moving another, forerunners of thunder; cause of this surprising appearance remains a secret; from sea, generally moister than those over tracts of land; more boisterous in spring and autumn than at other seasons; their force does not depend upon velocity alone, but also upon density; reflected from sides of mountains and towers, often more powerful than in direct progression; raise sandy deserts in one country, to deposit them upon some other; so hot in Egypt as almost to stop respiration, and produce epidemic disorders, continuing for any length of time; deadly along the coasts of the Persian Gulf, and of India; assume a visible form, 150

Windpipe, in men, has a lump not seen in women, i. 215. Makes convolutions within a bird, and is called the labyrinth; this difference obtains in birds seemingly of the same species, ii. 214. Strange in the throat of the crane, 357

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Winter, beginning round the poles, the misty appearance of heat in southern climates is there produced by cold, i. 164

Wististi, a monkey of the sagoin kind, remarkable for the tufts of hair upon its face, and its annulated tail, ii. 158

Wolf, a fierce, strong, cunning, carnivorous quadruped; externally and internally so nearly resembling the dog, they seem modelled alike, yet have a perfect antipathy to each other, ii. 15. Principal distinction from the dog is the eye, which opens slantingly upwards in the same direction with the nose, 16. Also the tail is long, bushy, hanging lank; the wolf lives about twenty years;

is not much with those of his kind, yet hunts in packs with them; quarrelling, they devour each other, ib. Is watchful and easily waked; supplied with water, lives four or five days without food, 19. Carries off a sheep without touching the ground, and runs with it swifter than the shepherds, his pursuers ib. Smells a carcass at a great distance; leaving the wood goes out against the wind; particularly fond of human flesh; follows armies, and arrive in numbers upon a field of battle, 20. Two or three wolves keep a province for a time in continual alarm; distinguished by huntsmen into young, old, and great wolf; manner of hunting them, ib. The wolf killed, no dogs show an appetite to enjoy their victory, 21. The flesh so very indifferent, no creature eats it but the kind itself; breathe a most fetid vapour from their jaws, 22

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Woodcock, or cock of the wood, of the grouse kind; places which this bird inhabits; how distinguished from other birds of the poultry kind; the delicacy of its flesh; its food and habitation; amorous desires first felt in spring; keeps to the place where he first courts, and continues till the trees have their leaves, and the forest is in bloom; its cry, clapping of wings, and ridiculous postures in this season, during which the females, attending his call, are impregnated; sportsmen use this time to fire at them, and take many while thus tame, though at others it is most timorous and watchful; the female much less than her mate, and so unlike him in plumage, she might be mistaken for another species, number and size of the eggs; she hatches them without the cock; and when obliged to leave them, in quest of food, so covers them with moss or leaves, it is difficult to find them; she is then extremely tame and quiet; keeps her nest, though attempted to be driven away; the young being hatched they run with agility after the mother, though scarcely disengaged from the shell; their food ants' eggs and wild mountain berries; older, they feed upon tops of heather, and cones of pine-trees; are hardy; the clutching time over, the young males forsake the mother; keep together till spring, when the first genial access sets them at variance for ever; fight each other like game-cocks, and easily fall a prey to the fowler, ii. 288

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